OCCUPATIONAL WELL-BEING IN ANESTHESIOLOGISTS

Brazilian Society of Anesthesiology (SBA) / Federal Council of Medicine of Brazil (CFM)

Sociedade Brasileira de Anestesiologia
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Occupational Well-being in Anesthesiologists

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Summary

Presentation

The occupational health and welfare of Brazilian physicians are points of concern of the Federal Council of Medicine (CFM). Nowadays, we live in times of great social, cultural, economic and political changes that directly impact on the physician-patient relationship, on the way medicine is exerted and on personal and professional lives of colleagues who fulfill their mission in hospitals, emergency rooms, and out-patient facilities.

In general, the absence of public policies that value the role of the doctor in assistance associated with the lack of investment in health eventually produce a scenario of dis-incentive and pressure on the professional who, unfortunately, in some situations, becomes victim of this neglect. Amid the real needs of patients and the indifference of the managers, the doctor has been pushed towards the brutalization of his/her postures, physical and emotional distress and the search for inadequate solutions to mitigate daily difficulties.

This issue assumes relevant proportions among anesthesiologists due to the characteristics of the specialty. However, the phenomenon is not isolated and should be treated. Aware of the implicit severity of this fact, the CFM - in an unprecedented partnership with the Brazilian Society of Anesthesiology (SBA) - created a National Commission for Ethics and Medical Assistance to the Chemically Dependent Physician Patient, announced at the conclusion of the First International Symposium on Occupational Health of Anesthesiologists, held in Brasilia in September 2013.

This book is one of the first products of this group. The compiled articles provide data relevant to the formulation of a diagnosis of the problem and suggest paths for future coping strategies. At first, anesthesiologists make up the focus group, but soon it is expected these benefits and services are expected to be extended to the entire population of physicians.

As occurred with a similar initiative, conducted by the Regional Medical Council of the State of São Paulo (Cremesp), which served as a mirror to the current proposal, both SBA and CFM are confident that they can contribute decisively to assist physicians in crisis, giving them new opportunities. Thus, our entities will make a difference as supports to rebuilt lives and careers.

Luiz Roberto d' Avila
President of CFM

Desiré Carlos Callegari
First secretary of CFM

Preface by the Brazilian Society of Anesthesiology

The Brazilian Society of Anesthesiology (SBA) provides its members - and the medical literature - with this book on the conditions necessary to ensure a high degree of safety and quality of life at work, calling into attention the urgent need for protecting the health of physicians, teaching to promote physical, mental, social and moral welfare, as well as the prevention, detection, approach / treatment measures and control of accidents and / or illnesses resulting from the practice of medicine, thus enabling the reduction of risky situations.

We can say that the Commission on Occupational Health of the SBA reaches his majority at this time, when it overcomes the internal perimeters of anesthesia and, in partnership with the Federal Council of Medicine, the Latin American Confederation of Societies of Anesthesiology and the World Federation of Societies of Anaesthesiologists, envisions, designs and implements the description of many relevant topics to the health of physicians in a single book, published in three languages - Portuguese, Spanish and English .

We have effective awareness of the importance of this book, which is why it has become so pleasurable. We hope to raise the readers understanding of the need for changes in personal attitudes, especially toward their behaviors in hospitals, clinics and at home, enabling them aided by the recommendations contained in this publication, to achieve professional welfare associated with personal happiness.

Airton Bagatini
President of the Brazilian Society of Anesthesiology, 2013

Preface WFSA

All people will experience stress during their lives. Stress after all is concomitant with modern living and whatever your job, it is likely that you will suffer moments of extreme stress. Sadly this seems to be beginning in childhood and when at school pressures are applied to 'succeed' and 'do well' by being able to paint, read, play a musical instrument and act in a play all before you are 6 years of age!! Life has become fantastically competitive so that parents seek to push their children and boast about impossible goals achieved which in turn increases the stress in others.

Stress is naturally related to income streams, housing, education, work, perceived success and then illness and dying. At times for many there seems no escape and this is true all over the globe in almost all cultures and countries. So if we now add onto this the stress of being responsible almost totally for someone's life (as the anaesthesiologist often is!) it is not really surprising that many people in our profession succumb to the pressures of this stress.

Human beings are fallible by definition and so all of us make mistakes. Modern life does not allow this as everything that goes wrong must be the fault of somebody or some organisation and they must pay recompense for the mistake. This compounds stress for the individual who, often for no obvious reason, errs.

So by accepting that all anaesthesiologists are under stress to varying degrees we have to find ways to recognise and then deal with that condition. It has been my experience that some people go and play the violin, some try to punish a squash ball by flattening it against a wall and others find kindred souls to whom they can talk and explore the situation in which they are placed. Others mistakenly deny themselves this respite and ignore it or turn to alcohol or drugs to try to remove the problem. This never works in the medium or long term. Of even more concern are the cultures, which may be national or just institutional, who consider it a failure to voice stressful experiences and this will cause suppression and later terrible problems.

In the past few decades more and more anaesthesiologists have looked to find ways to ease stress in themselves and in colleagues. It is now a regular topic at International Anaesthesiology Conferences and numerous articles have appeared in print. Sadly this is not enough and there is still an unacceptable rate of 'burn out' or even suicide amongst our profession.

Gastão Duval Neto, who chairs the WFSA Professional Well-being Committee, has with the help of the Brazillian Society of Anesthesiology, the Confederation of Latin American Societies of Anesthesiologists and the WFSA, created a wonderful book to try and help our profession further. He has brought together the foremost leaders in the field who have written carefully researched chapters which will show how stress can be recognised, lived with and finally overcome. But this book goes beyond just looking at stress and encompasses the whole of professional well-being

in all its forms. We hope that the book will be read by colleagues, wives, husbands, managers and other medical disciplines to permit an insight into the terrible stresses that can occur within our profession. I recall being told by one senior colleague as I started my anaesthesia training that *"anaesthesia was either awfully simple or simply awful!"*Although a trite statement it does have a certain basic truth but what is more worrying is that it is easy to substitute the word 'life' for that of 'anaesthesia' in that statement. This is then a subject which requires careful consideration by all who work in anaesthesiology to ensure that life or work events do not swamp either young or old lives.

We hope that this book will help people realise that they are not alone in experiencing hard times, that help is available and that taking this help will not be deleterious to their future careers; in fact it may save them.

David J Wilkinson
President, World Federation of Societies of Anaesthesiologists

Introduction

The publication Occupational Welfare in Anesthesiologists is based on the definition of the term, issued by the World Health Organization in 2005: "the perception of an individual about their position in life in the context of culture and value systems in which this and in relation to their goals, expectations , standards and concerns".

The main objective of this book is to address the pathological disorders of occupational well being in anesthesiologists (diagnosis, prevalence, prevention and treatment), based on epidemiological evidence, which affect in a complex manner and sometimes seriously the physical and mental health, personal beliefs and social relations of the anesthesiologist, as well as the care of patients under their responsibility.

The content has been grouped into three basic sections: (1) principles and fundamentals of occupational health, (2) institutional responsibilities with anesthesiologists' occupational wellness, and (3) biological hazards and occupational health and interdisciplinary aspects of occupational health.

It is important to acknowledge that research on the pathological changes regarding occupational welfare in anesthesiology either in experimental or clinical environments, is highly complex and difficult due to its multifactorial nature, especially in regard to occupational fatigue and its consequences, which vary over time in different individuals (individuality character of the pathology), and the clinical overlap with other conditions associated with it, such as depression/psychogenic stress, burnout, substance abuse, suicidal ideation, among others .

It is vital to acknowledge that physicians, including anesthesiologists, are trained to exercise his practice focused on the health of patients, so that they often neglect their own health issues as well as the conditions of their occupational well-being.

To anesthesiologists, this book should be considered a big step toward the understanding of occupational health problems secondary to changes in the status of occupational well-being that require attitudes and solutions based on the premise: "To be aware of the problem is the first step to its solution".

Therefore, this book aims to stimulate the development of effective action on the part of world entities involved with anesthesiology, in favor of the occupational health of anesthesiologists and safety of their patients. In this opportunity I wish to thank the Brazilian Society of Anesthesiology (SBA), the Federal Council of Medicine of Brazil (CFM), the Latin American Confederation of Societies of Anesthesiologists (Clasa) and the World Federation of Societies of Anaesthesiologists (WFSA) for realizing the importance of this project and fully supported its development.

I wish to acknowledge the voluntary and highly competent work all authors who faced the proposed challenges; the high quality of the work done by the SBA information technology team, under the leadership of their manager, Mercedes Azevedo; the CFM staff responsible for the printing of this book; and the excellent review of the texts and their translations, under the responsibility of Prof. Dr. Getulio Rodrigues de Oliveira Filho.

Gastão F. Duval Neto
Editor

- Part 1 -
Principles and basis of occupational health

Evaluation Of Anesthesiologists' Occupational Well-Being Around The World

Gustavo Calabrese Torchiaro
President of Latin American Confederation of Anesthesiology Societies (CLASA), 2013.

1. Introduction

The World Federation of Societies of Anaesthesiologists (WFSA) and its affiliates are increasingly concerned about the lifestyle and occupational hazards related to the practice of anesthesiology. Therefore, in order to warn anesthesiologists about occupational risks and develop strategies to improve quality of life, the WFSA Professional Well-being Comittee conducted the worldwide survey Professional Well-being Work Party.

2. History

In the early 20th century, fires and explosions inside the operating room caused by inhaled anesthetics were the major occupational risk associated with anesthesiology. Later, problems related to chronic inhalation of anesthetic gases and contamination of the surgery room were highlighted.

During the 80s, focus shifted to the risk of exposure to biological agents and chemical dependency among anesthesiologists. Currently, many occupational risk factors are under study, including biohazard, opiod abuse, occupational stress, burnout and working patterns. Long working hours, stressful environment, pressure to obtain greater productivity and frequent exposure to physical, chemical, biological and ergonomical risks are part of anesthesiologists' current routine.

These factors result in health, safety and performance hazards to practitioners and affect their quality of life as well as that of their families. This is why anestesiology offers "high occupational risk" compared to other healthcare professions.

3. Classification

Currently, anesthesiology occupational risks are classified according to the type of agent or situation that triggers the hazard, including[1]:

Risks related to anesthesiology practice:

- Chronic occupational stress
- Psychosocial disorders
- Drug addiction
- Ergonomics

Risks related to biological agents - Infections transmitted by patients with the following pathogens:

- Viruses: hepatitis B, hepatitis C, HIV
- Bacteria
- Fungi
- Others

Risks related to safety and physical agents:

- Ionizing radiation (RX)
- Non-ionizing radiation (laser)
- Noise and vibration
- Temperature
- Ventilation
- Lighting
- Electric charges (high and low voltage)
- Fires
- Compressed gas (cylinders)

Risks related to work standards (organization):

- Organization and type of work
- Work pattern
- Calendar, workload, density of tasks
- Violence

Risks related to chemical agents:

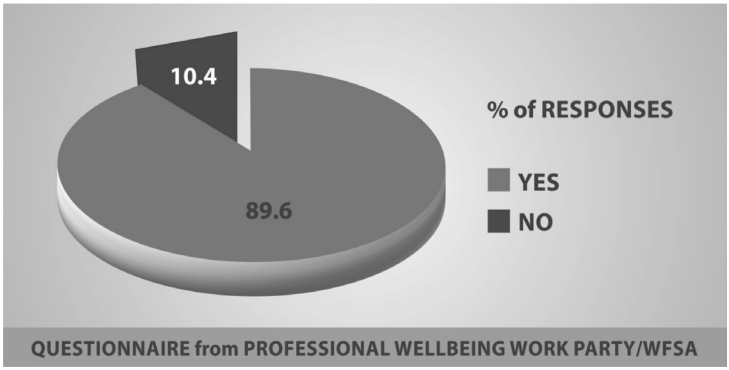
- Latex allergy
- Exposure to inhaled anesthetics (reproductive hazards)

4. Which of these factors has the greatest impact on anesthesiologist's life?

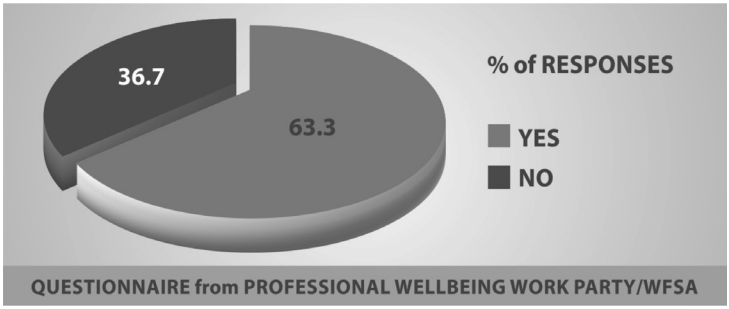
The Professional Well-being Work Party[2] research, conducted by the WFSA Professional Well-being Comittee, led by Professor Dr. Gaston Duval Neto, from Brazil, reported worldwide situations concerning anesthesiologists' occupational problems. It also identified regional diferences and highlighted occupational stress issues, including burnout syndrome and problems related to organizational work patterns.

These are the following issues.

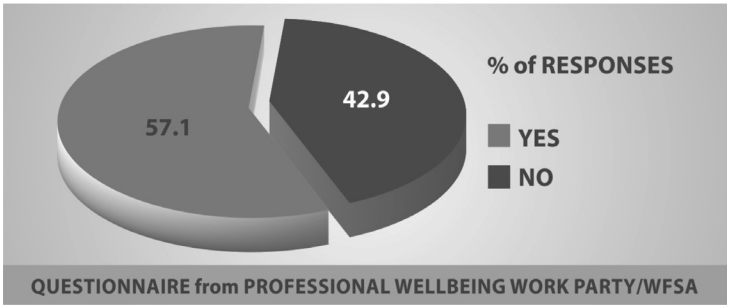
Do you believe that "Physician Burnout Syndrome" is a problem of concern in your society?



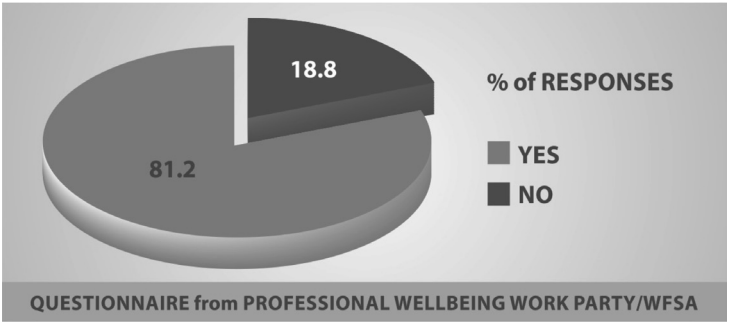
Are the members of your Society aware of the concep of "Working Time Regulations"?



Do you believe that substance abuse is a substantial problem amorg anesthesiologists in your Society?



Does your Society have a particular group working on the subject "Professional Well-being of Anesthesiologists?



Occupational Stress

Occupational stress is defined as the physical and emotional reactions that occur when demands at work exceed the capacity, tolerance, resources and needs of the anesthesiologist.[3] Excessive stress can lead to serious consequences such as worsening work performance, having huge impact on the safety of patients and anesthesiologists alike, and compromising professionals' health and family lives.[3-6]

Incidence

While the incidence of occupational stress among all doctors is 28%,[7] it is even higher among anesthesiologists, reaching 50% in Europe and 59% [9]- 64% [10] - 96% in Latin America.[11]

Similar results were found in other studies that relate occupational stress to many different factors in the complex routine of anesthesia. Recent research showed that the most stressful factors in anesthesiologists' opinions were: lack of control over their workday (83%), jeopardized family life (75%), medical and legal aspects (66%), communication problems (63%), clinical problems (61%).[12] Other studies reported: work standards (58%), management of critical patients (28%), crisis management (23%), dealing with death (13%),[9] problems related to work pattern (organizational, 42%), administrative responsibilities (41%), personal conflicts (35%), conflicts in professional relationships (25%), conflicts outside the work environment (23%), medical and legal problems (2,8%).[13] Among anesthesiology residents, the main concerns were managing critical patients, dealing with patients' deaths and balancing personal life with professional demands.[14]

Mechanism of action:

Stress cycle

Chronic occupational stress is dynamic and insidious. The continuous cycle of stress causes gradual and permanent damage to the body.[3] Among anesthesiologists, many factors can trigger occupational stress, especially[(5-6)(16-21)]:

- Specialty type
- Work complexity
- Stressful environment
- Lack of control over the work routine
- Jeopardized family life
- Possible legal and medical problems
- Professional expectations
- Job insecurity

Impact of occupational stress

When the previously reported stressors accumulate and overcome one's tolerance, excessive stress settles in and can have a major impact on health, work and family life. [5-6]

Health Impact

Occupational stress exerts major impact on one's health, gradually but permanently compromising biological systems and even causing physical diseases, intellectual changes, mental and behavioral disorders.[3,5,6]

A) Physical diseases: chronic fatigue, gastroduodenal ulcer, gastritis, hypertension, arrhythmia, angina, musculoskeletal diseases, neurological disorders, decreased immunity, reproductive disorders and increased risk of spontaneous abortion. [3,5,6]

In Latin America, the most prevalent effects are:[9]

- Gastrointestinal tract, with the incidence of gastritis and gastroduodenal ulcer of 45% and 11%, respectively;
- Cardiovascular, especially hypertension in 23%, arrhythmia 13%, angina 5 % and myocardial infarction in 3 %.[9]

B) Psychological disorders: psychic emotional deterioration, such as anxiety (19 %), distress (43 %) and depression (31%). Increased risk of suicide.[9]

It should be noted that the incidence of depression among anesthesiologists and anesthesiology residents is higher than in general population, 11% , 31% and 40% , respectively.[9]

C) Behavioral disorders: alcohol abuse (44%), psychotropic drug use (16 %), drug abuse (1,7%) and aggressive behavior.[9]

D) Intellectual changes: difficulty to concentrate, impairment of vigilance, reduced work performance.

Family impact

It is characterized by difficulties in balancing work and family life, failure in establishing or maintaining relationships with one's children, difficulties in marital relationship, lack of emotional support, isolation, divorce and family breakdown.[1-4]

Work impact

Important features are lack of interest in work, absenteeism, dissatisfaction, low-quality work, possibility of medical malpractice, which may occur through negligence and result in legal problems. All these situations denigrate the professional's image and may sometimes result in career abandonment, premature retirement and, in extreme cases, civil or criminal issues that can even lead to suicide.[3,5,6]

What should we do about occupational stress?

Early diagnosis, medical and psychological treatment in symptomatic cases are essential. Treatment should aim for significant changes in quality of life, including changes in eating habits, sleep, rest, satisfaction and greater work opportunities. Possible instruments to achieve these changes are appropriate work schedules, work, family and social life balance, adequate work infrastructure, occupational protection and improvements to the workplace.

Recommendations

"The major obstacle is the physicians' resistance to recognize their problems and accept their position as patients." Preventive measures are recommended in order to reduce the prevalence of chronic occupational stress and its devastating consequences. Occupational diseases are a "shared responsibility"; therefore, prevention should be approached from three perspectives: personal, work team and institutional level.[15] Primary prevention consists in eliminating and/or reducing possible stressors, while secondary prevention is characterized by early detection of depression and anxiety symptoms and tertiary prevention involves recovery and rehabilitation. [3,5,6,15]

Individual level: [15]

An individual adjustment process to daily expectations is recommended:

- Not denying the situation
- Avoiding isolation
- Decreasing the intensity of routine
- Reaching balance between family, friends, work and rest
- If necessary, seeking for professional psychological counseling

Team level: [15]

Co-workers are key to early diagnosis and support.

Anesthesiologists should require their employers (hospitals and clinics) to have an occupational health program, a place to share experiences, professional support to improve interpersonal relationships and to seek for a more humanized, compassionate and less competitive workplace.

Institutional level: [15]

Hospitals and clinics must have an occupational health program focused on anesthesiologists, to prevent stressors and to offer psychological counseling, support for physical diseases, prevention and treatment of possible behavioral changes and drug abuse. A specific mental health program is also helpful. [15]

Institutional positive attitudes:

- Trying to assure balance between the amount of work and anesthesiologist's skills and resources;
- Providing opportunities for professionals to use all their skills - there must be a meaning for each activity accomplished;
- Defining roles and responsibilities of the anesthesiologist clearly;
- Involving anesthesiologists in the decision-making when potential changes affect their routine;
- Optimizing communication;
- Reducing uncertainty - setting career plans and exploring future job opportunities;
- Providing opportunities for social network among workers;
- Establishing schedules (working hours) that match anesthesiologists' demands and responsibilities;
- Fostering balance between work, family and social life;
- Improving safety measures inside the operating suite;
- Improving infrastructure.

Burnout Syndrome

Many different physical and mental illnesses may be associated with occupational stress. Burnout syndrome is defined as a physical and emotional response to occupational stress [8,22-24], characterized by emotional exhaustion, depersonalization, feelings of incompetence and failure to meet targets. [5,6,24-34] Burnout syndrome affects quality of life and professional performance. Anesthesiology is a high risk profession for burnout. [1,8,24-34]

Risk factors:

Burnout syndrome is associated with chronic and cumulative imbalance between psychological and professional demands, along with other issues related to work organization, such as [22,23,24-34]

- Work overload
- Injustice
- Lack of professional recognition

- Conflicts of principles
- Relationship conflicts with co-workers
- Loss of control over tasks
- Excessive bureaucracy and other institutional, environmental and personal particularities

Causes

The most important determinants of occupational stress include: history of 7-10 years of employment, long working hours, night shifts, work overload [35-40], professional commitment, responsability roles (the position of head of anesthesiology services is an important risk factor, as it increases in 51% the incidence of Burnout syndrome [33]) , lack of control over routine, personal life and family relationships, chronic fatigue and unfulfilling relationships at work. [24-34]

Development

Burnout is a gradual, cumulative and chronic process, commonly associated with denial. As it develops, factors like lack of professional recognition and achievements ruin the anesthesiologist's idealism, leading to emotional exhaustion, depersonalization and professional indifference that affects the quality of healthcare provided, as well as the professional's quality of life. [24-34] There is a certain irony in the burnout process – the once-enthused, committed, energetic professional that was once full of innovative ideas and high expectations gets frustrated after being confronted with so many obstacles for a long period without enough results. Butnout syndrome may present many physical, psychological, behavioral, professional and personal symptoms.

Symptoms [24-34]

- Physical: fatigue, sleep disorders, headache, impotence, gastrointestinal disorders.
- Psychological: irritability, anxiety, depression, hopelessness.
- Behavior: aggressiveness, defensive behavior, cynicism, drug abuse.
- Professional: absenteeism, decreased performance, lack of commitment.
- Personal: poor communication, isolation and poor concentration.

As it develops, burnout syndrome may cause serious consequences, such as:

- Car accidents related to heavy workload, especially at night.
- Several psychological/psychiatric disorders, mainly anxiety, distress and depression.
- Drug abuse (escape mechanism).
- Suicidal ideation

The prevalence of suicide among patients in advanced burnout stages is six times higher than general population. [6]

Recommendations

Recognizing the concept of shared responsability is essential in the management of occupational illnesses. Preventive measures should be taken in three fronts: personal, team and institutional level. [15]

Personal level [15]

Individual prevention is accomplished through the association of knowledge, education, anticipation and control of potential stressor factors. Denial will only delay diagnosis and intervention, so it should be avoided. Professionals must learn how to say "no", how to delegate and to reduce their own workload. In this process, the main difficulty is usually the physians' resistance to admit the existence of an emotional and/or psychological problem.

Behavioral changes, prioritizing protective factors against burnout syndrome are necessary for an improvement in quality of life. Adjustments in eating and sleeping habits, time for leisure and family are the main goals. [15]

Team level [15]

Co-workers have an important role:

1. Usually the first ones to notice and make an early diagnosis.
2. Coleagues can help each other to reflect on their experiences.
3. Coleagues can provide psychological support in or out of the workplace, since they experience similar situations.

Institutional level [15]

Companies that deal with anesthesiologists in their staff should develop occupational health programs that include mental health and counseling for professionals that develop burnout symptoms.

Institutions must devise strategies for early recognition and diagnosis of individuals at risk and provide medical and psychological support in symptomatic cases.

Work organization

Anesthesiologists' work environment and conditions underwent major changes in the past years, thanks to globalization, new market trends and new health management models. [41, 42] In this context, occupational risks related to work organization are highlighted, especially in terms of working hours. [1,37-40]

Risk Factors

The imbalance between workload and time for rest and leisure underlines a major risk factor: inadequate work schedules. [1,15,37-40]

Causal factors

Anesthesiology is a career that requires excessive working hours, at day and night, with a lot of overtime and night shifts followed by a tough day of work, leading to intense workload without adequate places to rest. [1,37-40]

Effects

Inappropriate work schedules may trigger sleep and circadian rhythm disorders, fatigue, cardiovascular and digestive changes, and compromise family life. Initially, the impact will show on the professional's health and later it will be reflected on his performance, occupational well-being and patient safety. [43-45] Circadian rhythm changes lead to alterations in digestion, sleep, body temperature, adrenalin secretion, blood pressure, heart rate and behavior. [46] Fatigue can cause mood disorders, depression, headaches, dizziness, loss of appetite and digestive problems. [46-47] It can also cause gynecological problems such as irregular menstrual cycle, premature labor [48-50], intrauterine growth restriction resulting in SGA (small for gestational age[51]), pregnancy-induced hypertension[52]. Fatigue reduces patient safety, as it affects doctor's decision-making skills, which increases the probability of "human error" [1]. In anesthesia, "human error" is so relevant that studies reported it as the cause of critical situations in 83% of the cases[53,43]. Reports show a contribution of fatigue in 50% of medical errors [55] and in 60% of malpractice cases among anesthesiologists [56]. Other studies show that fatigue contributed to errors in the management of anesthesia in 86% of the cases. [43] Furthermore, fatigue was associated with critical events in anesthesia management in 2% [53], 3% [57] and 6% [58] of cases and with drug administration errors in 10% [54].

Schedule changes and the absence of a sleep routine may trigger sleep disorders. Cumulative sleep deprivation and reduced REM sleep period - restoring sleep - can result in a "sleep deficit" and then progress to a state of chronic sleep deprivation. [59] This may cause immune [60], gastrointestinal[61] and endocrine disorders[62] and decrease psychomotor performance[63], contributing to medical malpractice.[46] The period between 2 and 7 a.m is the one of most vulnerability to sleep. [64] These are the key moments when sleep deprivation, lack of proper sleep during night shifts and inappropriate schedules increase the chances of human errors in anesthesiology.

Fatigue can also be associated with occupational accidents during night shifts, increasing by 50% the risk of exposure to contaminated blood (HIV, hepatitis B and C). [65]

Recommendations

Develop a work system with predefined limits: working-hour limit per day/week, breaks between long working periods, overtime and night shifts, time to rest between shifts, weekly rest schedule, annual vacations. [1,66] It's recommended that anesthesiologists voluntarily start the following preventive measures: [1,15,66]

- Working no more than 48-50 hours/week .
- Not working more than 5 or 6 hours without small breaks in between.
- Not working more than 10 consecutive hours per day.
- Balancing work and family life .
- Avoiding more than two overnight shifts of 12 hours per week.
- Distributing days off evenly.
- Not working for two consecutive shifts.
- Not taking on another shift without a break of at least 10 hours between them.
- Resting and restoring sleep on the day after a 24-hour shift.
- Establishing a 30-minute break during 8-hour shifts.
- Establishing two 30-minute breaks during a 12-hour shift, one of which should occur at a suitable time for dining.
- Avoiding night shifts after being 55 years of age.
- Having a 15-day leave for every four months of work.

There must be a well-structured room for anesthesiologists to rest and take a nap during breaks, dining and reading places with air conditioning, silence and no environmental pollution. [66]

Drug Abuse

In recent years, there has been increasing concern about occupational well-being among anesthesiologists. The worldwide survey Professional Well-being Work Party guided by the WFSA Professional Well-being Comittee showed that 42.9% of anesthesiology societies consider professional well-being an important matter. In Latin America, problems related to chemical dependency among physians are evident, especially among anesthesiologists. [67]

Drug abuse among anesthesiologists is a serious and complex problem, which involves addiction to drugs available in anesthesia practice. [67-73] This chapter will focus on opiates, due to the large impact that the use of this drugs can cause on residents' and specialists' lives, leading to progressive deterioration of health and lifestyle, withdrawal syndrome, possibility of relapse, psychiatric disorders (mostly depression and anxiety), comorbidity and even death by suicide or overdose. [67-73]

Incidence

Drug abuse among anesthesiologists is a serious concern. Recent studies, such as that of Barreiro and colleagues, report that anesthesiologists have greater potential for psychoactive substance abuse than general physicians. [74] Hughes and Paris confirm that statement and report that opioid consumption is the most common addiction among anesthesiologists. [75,76] Real data about drug abuse and addiction among

physicians and especially among anesthesiologists are difficult to obtain, so most of the information comes from retrospective studies and/or data provided by treatment programs in prospective studies.

Retrospective studies in the USA, reported the incidence of drug abuse ranging from 1 to 5% among anesthesiologists.[77-79] Only 4 % of physicians are anesthesiologists in the U.S.A., however they represent 12-14 % of all the doctors admitted for chemical dependency treatment.[80] 50 % of those patients were under 30 years, a third of them were residents and opioids were the main problem (especially fentanyl).[80]

A study that included 133 anesthesiology residency programs in the U.S.A. showed a 1% incidence of drug abuse among specialists and 1.6% among residents.[81]

Among physicians being treated for drug abuse, 33.7 % are anesthesiology residents, which makes the incidence of drug abuse in this group 7.4 times higher than the incidence among residents of other medical specialties.[82]

The striking features of chemical dependent anesthesiologists are: 50 % are younger than 35 years old, with higher rates among residents, 67-88 % are males, 75-96 % are caucasian, 76-90 % are primarily opiod dependent, in 35-50% more than one drug is used, 33% have a family history of drug abuse and 65% were associated with academic departments.[83]

A study conducted by CLASA in 2000 revealed that 16 % of anesthesiologists in Latin America use illicit drugs – 1.3% suffer from opiate abuse and 0.4% use sedatives and hypnotics.[9] A recent report by the CLASA 2013 Occupational Risk Commitee shows that in the last 10 years, there were 156 recorded cases of drug abuse, in which 121 were related with opiates, 20 with sedatives and 15 with hypnotics.[84] The records also showed 140 apointments for drug abuse, particularly opioid consumption.[84]

Risk Factors

Drug abuse is a complex situation, influenced by many general and specific factors.

General factors

General factors are related to the abuse of any drug, and genetic predisposition, psychosocial and biological factors, personal history and/or family history of drug abuse should be considered.[71-73] Genetic predisposition contributes to dependency, with biochemical changes in the brain associated with dopaminergic receptors.[71-73] The association of genetic predisposition with experimental use increases the risk of developing addiction. Family history represents a risk factor.[71-73]

Specific factors

Specific factors for anesthesiologists are:[71-73]

1. Anesthesiology imposes a heavy workload and comprimises professionals' quality of life, causing physical and mental stress. Besides, pressure to perform,

fatigue and sleep deprivation cause chronic occupational stress and may trigger the burnout syndrome.

2 . Availability, easy access and lack of control over drugs.

3 . Addictive potential of opioids

4 . Lack of control over psychoactive medications.

5 . Curiosity to experience its effects.

6 . Lack of self-esteem.

7 . Denial of the situation.

Consequences

The intire evolution of the problem starting from the use, abuse, addiction and finally dependency on drugs must be unsderstood, because once it deteriorates the anesthesiologist's life, serious personal, family, professional and legal problems may occur. [71-73]

Personal consequences

In some cases, personal consequences are very important and serious, leading to a progressive deterioration of living and health conditions, withdrawal syndrome, possibility of relapse, comorbidities, psychiatric disorders (anxiety and depression) and death by overdose or suicide. [71,73,85-88]

Death and suicide

The incidence of relapse is high among previously opioid-dependent anesthesiologists, much higher than among non-opioid drug addicts and alcoholics. [89] The incidence of relapse among anesthesiologists that return to their daily practice ranged from 19 %, 26 % [90] up to 40% [91], and death was the outcome in 16% of those first relapses [92].

The specific risk of death by suicide related to drug overdose was two times higher among anesthesiologists, and the risk of drug-related death was three times higher among anesthesiologists compared to clinicians, especially during the first five years of residence. [93]

The 2013 report of the CLASA Professional Risk Commission revealed that in the last 10 years there were 141 drug-related deaths, including 94 cases of suicide and 47 cases of overdose; six deaths by propofol and 135 by opiates (118 specialists and 15 residents). [84]

Saxon countries developed a 10-year survey and found a similar situation, with 285 deaths 10% of which were related to overdose [94]. In a 5-year period, overdose corresponded to 16% of 44 death cases [92]; in a 2-year period, there were 26 drug related deaths in the New York Hospital[95]. Recently, in Australia and New Zealand, 44 cases of opiate abuse were recorded, 24% of which resulted in death. [88] Ultimately,

drug-related death or suicide by overdose are one of the most significant occupational risks in anesthesiology. [1]

Family consequences

Drug abuse also affects family life, and divorce rates can reach 24% among addicted anesthesiologists, compared to 5 % in non-addicted. Family members of addicted anesthesiologists are more prone to drug use and abuse. [71-73, 95]

Consequences at Work

This problem can affect the professional's capacity to work and even prevent professionals from performing their daily activities, as well as compromise patient safety and raise the rates of malpractice. Drug dependency may require the abandonment of the specialty, as it may be quite hard to return to anesthesia daily practice. [71-73, 95]

Legal Consequences

Legal consequences are controversial, due to the complexity of the disease and legislative differences among countires. Certain countries consider the addicted professional as uncapable and demand a recovery process followed by changing medical specialty. In case the anesthesiologist presents a successful treatment and recovery, showing normal control exams, they can't have their job denied. [71-73]

Behavior [15,97, 97]

How should a suspected case of drug addiction be approached?

In case of suspicion of drug addiction, administrative, clinical and pharmaceutical information must be obtained in order to identify the addicted professional and proceed with the investigation. After confirmation of drug dependency, an intervention is needed because that person has a disease that requires treatment. The hospital committee associated with a committee organized by the anesthesiology society must refer the professional to treatment programs.

This treatment should be guided by a multidisciplinary team: psychiatrist, general practitioner, neurologist, nutritionist, social worker and it should also involve family members. This process may take several months or years, depending on the case and the family.

Return to work

This is a crucial stage, the decision about future professional activities. The reintegration process contemplates different scenarios: work, family and society. Returning to anesthesia practice is a difficult process for opioid-addicted anesthesiologists that are still in their recovery process, so decisions are controversial and cases must be individualized. [86, 96]

Recommendations [15, 96, 97]

There is no way to guarantee that the use of psychoactive drugs will not cause dependency, so the only guaranteed protective measure is to avoid the first use of any illegal drug. Therefore, a comprehensive strategy involving anesthetists, societies and/or associations of Anesthesiology, health authorities and employers is crucial.

Preventive policies

Programs should be based on joint prevention strategies:

- Dissemination of education and information.
- Identification of anesthesiologists potentially at risk for addiction.
- Management of occupational stress.
- Better work schedules.
- Strict and continuous control of psychoactive medications.
- Policies to support anesthesiologists and their family.

Conclusions

Occupational hazards associated with anesthesia practice are responsible for the current harsh and disturbing reality faced by anesthesiologists that have their life, health and family conditions comprimised. In this scenario, shared responsability must be highlighted under three perspectives:

1. Anesthesiologists should always be updated about occupational health issues.
2. Medical institutions must develop prevention and protection programs with the objective of identifying potential addicts, controlling risk factors and drug distribution.
3. Societies of anesthesiology must act through comprehensive policies:

- Information and education
- Support systems
- Rehabilitation programs
- Economical endorsement for colleagues and their family, when needed.

For that, an Occupational Health Program is vital.

Reflections:

Drug addiction is a lifelong disease. Its acute effects can be overcome, but its consequences leave their marks forever in each victim.

Despite significant advances on the basis of drug abuse, technological support and current therapeutic approach, this disease still represents a major occupational problem for anesthesiologists. [96]

5 . Strategies

The Professional Well-being Work Party conducted by the WFSA Professional Well-being Committee showed the lack of institutional strategies related to anesthesiologists' occupational well-being - 81% of institutions deny having a dedicated occupational well-being committee. Therefore, it is recommended that Anesthesiology Societies or Federations develop an institutional policy that allows the study of occupational hazards and the improvement of strategies.

1. Each anesthesiology society or federation should have an Occupational Health Committee. [15, 98]

The main strategy aims to identify and quantify the risk factors, develop ways to reduce those risks, establish educational and preventive policies, make good treatments feasible, if possible, organize a fund to help anesthesiologists and their families with financial support.

2. Occupational Health Integrated Program[98]

An Integrated Occupational Health Program aims to achieve better working conditions. The Occupational Health Committee of Anesthesiology Societies must devise improvement actions and each institution must execute it respecting their work and regional particularities.

The main goal should be the promotion of better physical, psychological and social conditions for anesthesiologists, in order to prevent occupational accidents and illnesses.

The program must have specific goals, such as:

a) Analyzing work conditions to identify possible risk factors in anesthesiologists' daily work.

b) Keeping track of risk factors. Establishing priorities.

c) Monitoring and controlling risks. Medical examination once a year.

d) Establishing a system to gather periodic information for an updated data basis.

e) Planning and organizing work activities to reduce the main risk factors, considering the workplace and people involved on it. Guidelines to coordinate work and rest hours, analysis of workplace infrastructure and security.

f) Organizing training activities according to the institution's risk factors.

g) Shared responsibilities among different organizational levels to ensure continuous improvements for worker's health and safety.

h) Creating safety and surveillance standards to prevent occupational accidents and diseases.

i) Assessing the impact of those actions on the incidence of occupational accidents and diseases.

j) Defining preventive measures to improve working conditions and anesthesiologists' health and quality of life. Prevention and safety guidelines, as well as protocols about Management of Risks are necessary.

k) Planning, organizing and developing training meetings.

l) Asking for proper medical attention in case of occupational accidents, diseases or disorders. Importance of agreements between medical institutions for mental healthcare, substance abuse , etc. .

Final thoughts

Despite improvements in safety standards, technology and new drugs, anesthesiologists continue to suffer the occupational hazards associated with this specialty. There must be a genuine concern about this topic and effective strategies to avoid occupational problems must be established, prioritizing continuous education, prevention policies, professional protection and support, standardization and, ultimately, improvement in the conditions to practice anesthesiology are necessary to guarantee anesthesiologists' health and quality of life. Thus, physicians become specialists in order to help and take care of patients' health, but they often forget to take care of their own health. (1-2, 96, 99)

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The stress caused by medical emergencies. Fatigue and its correlation with diseases, suicide and medical malpractice

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Introduction

Patients should be treated by expert healthcare teams that perform as well as possible in efforts for good outcomes.

What sets anesthesiology apart from other medical specialties is the need for constant vigilance for possible emergencies. This poses exceptional pressure on performing within strict standards and therefore impacts anesthesiologists' occupational health.

Physicians must exert all their knowledge, manual skills, dexterity and attitude (technical and non-technical skills) in clinical practice, even (and especially) in adverse situations, at any time of day or night, in order to maintain standard of care.

Anesthesiologists commit to remaining alert and being able to manage crises that may arise at any moment in the operating room. However, physicians' degrees of attentiveness vary throughout 12 or 24-hour shifts and sustaining a high level of watchfulness is difficult. For that reason, there is worldwide concern regarding the safety of surgical patients. Such high professional expectations lead to diminished occupational well-being, so the aim of this chapter is to investigate a manner of offering patients the best healthcare possible without imposing on physician well-being.

Fatigue in medical practice

Anesthesiologists are highly skilled professionals, trained to make quick decisions and perform complex procedures under pressure. Due to technology advances in diagnostic and treatment options, the number of patients is ever-growing, and so is the expectation for good results. Daily workload requires consistent performance, which is challenging for overworked professionals who have to be available for emergency calls, either in the hospital or at home.

Burnout syndrome has been defined by psychologist Freudenberger and psychoanalyst Maslach[3] as the combination of specifically work-related fatigue, emotional exhaustion and depersonalization[1,2], unlike depression, which is related both to people's professional and personal lives.

Leaders in different areas, such as tutors in anesthesiology training programs, are exposed various forms of occupational stress that can trigger burnout syndrome. A survey of 102 anesthesiologists found that 28% of them have had the syndrome and, based on the Human Services Survey questionnaire, a version of the Maslach Burnout Inventory (MBI - HSS)[4-7], 59% of respondents were at high risk of burnout[8].

Although they don't necessarily practice clinical anesthesiology anymore, these professionals are greatly predisposed to occupational stress. This highlights the existence of other stressors, such as worries about the betterment of patient care, ever-reducing salaries, research and education budget constraints, medicolegal concerns, fostering the search for excellence in trainees, unprepared or insufficient staff and lack of collaboration from administrative authorities.

In comparison with other specialties, such as obstetrics-gynecology[5], ENT and ophtalmology[9], anesthesiologists show more signs of fatigue, emotional exhaustion and depersonalization.

Fatigue is a physical, emotional and psychological state influenced by factors considered uncontrollable by physicians, since they deal not only with patients but also with groups of individuals: hospital employees, administrative staff and patients' families. These interpersonal relationships inevitably lead to weariness due to the heterogeneous behavior of the many people involved. Fatigue can also be defined as a symptom of acute or chronic disease[10].

TABLE 1. Fatigue and its causes in medical staff

Fatigue
In-Hospital Causes
Group relationship
Technologic resources
Lack of appropriate tools (medicines etc.)
Lack of training
Job instability
Excess workload both in hours and quality
Ex-Hospital Causes
Family instability
Friends' influences
Dissatisfaction with one's home

The constant search for success that is currently promoted causes great anxiety to doctors, who question what success really means: good income, large workload, academic or social status or good patient-physician rapport. In fact, successful physicians are those who have good technical and non-technical skills, including the ability to manage their team with respect and responsibility in order to create a healthy workplace environment. This results in better interpersonal relations, diminished occupational stress and, consequently, reduced risk of fatigue.

Objective evaluations of qualitative and quantitative factors show that even small efforts when performed for extended periods can become hard work. This is what

occurs in anesthesiology, where shifts are stressful for the extensive workload and may or may not be worsened by the severity of patients' illnesses.

The physician's outlook on office hours is important as well. Less experienced physicians, with less expertise in handling crises, tend to see shifts as more stressful due to their great concern about non-maleficence. Shift-related fatigue and emotional stress are therefore bigger in these doctors than in experienced ones, independently of the amount of working hours.

Scientific discoveries and innovations have undoubtedly expanded our knowledge of biological sciences. Concepts such as human genome[11], cloning[12], robotic surgery[13,14] and many others have made technology an essential tool in the medical profession. Anesthesiologists can and should use technology to their advantage in clinical practice, but there is no substitute for solid medical knowledge, since scenarios with limited technological resources, medicines and tools are not uncommon and result in occupational stress, often triggering fatigue and indifference. Adversities may be inspirational for creative professionals with high self-esteem and good problem-solving skills, but in the long run, lack of resources may lead to fatigue and depression, with unforeseeable consequences.

There are three recognized forms of fatigue[15]:

a. Transitional: caused by sleep deprivation or prolonged periods of sustained attentiveness.

b. Cumulative: caused by moderate sleep deprivation or extra hours of alertness over many consecutive days.

c. Circadian: professional performance is diminished during the night, which is specifically dependent on the circadian cycle.

Fatigue, in all its forms, is inversely proportional to safety in all means of transportation and in chemical and nuclear industries[16-19] and there are various disastrous examples of the consequences of human errors. In 1920, a sleep psychologist called Stiles described fatigue as an imbalance between destruction and renovation[20], a transient but harmful result of bad habits.

According to a questionnaire-based survey of 647 anesthesiologists, 49% of them admitted to having made medical mistakes attributable to fatigue; 63% of whom hypothesized that such errors may have been the result of work overload leading to faulty pre-anesthetic evaluations in 14% of the cases[21].

In order to perform high-risk procedures, professionals must be in their absolute best physical and mental condition. However, the debate concerning medical fatigue cannot be limited to such high-risk situations, since low-risk procedures performed by fatigued professionals may eventually pose high risk as well. Both body and mind must be well and in harmony in order to assure the best possible professional performance. Approximately 20% of land transport accidents

involve fatigued drivers, an incidence higher than that of alcohol- and drug-related accidents[22].

It is known that even if working hours are not excessive, alterations of the circadian cycle and rest/sleep patterns can lead to fatigue. Sleep influences physiologic processes such as the release of hormones and enzymes, the construction of memory and processes of vigilance, attentiveness, communication and cognition[23-28], which affect directly the capacity for analysis, thought formulation and decision-making. Furthermore, the integration of logic and manual skills is affected, as evidenced by reduced agility and precision in procedures. One alternative to reduce the effects of fatigue is to slow the pace of task execution, an attitude known as speed-precision compensation[29], but this does not guarantee sustenance of service quality and safety. This compensation mechanism is studied by neuroscientists and describes the effect of high speed on the quality of task execution, such as in automotive races when a pilot spots an accentuated curve and faces the dilemma of slowing down (option 1) or sustaining high speed (option 2). Option 1 delays achievement of the goal but enhances security, whereas option 2 allows sooner goal achievement at the cost of a higher risk of losing control of the vehicle, making it a less secure alternative. In this case, choice is made on a risk-benefit analysis.

This, in Medicine, is analogous to fatigued, sleep-deprived doctors suffering administrative, economic and psychological pressures to maintain performance and productivity levels at the cost of patient safety and physician well-being.

Job offers may be accepted due to financial - or working-hour-related reasons. The sleep-wake cycle is a physiologic process essential for the maintenance of cognitive efficacy, but people have different biological clocks and different cognitive, endocrine and genetic expression patterns that affect their lifestyle. Individuals may be classified according to the time of day when they feel most active in: early, late or intermediate. In case these particularities are not respected in their work choices, anesthesiologists will face physiologic incompatibilities intensified by heavy workload[31,32].

Suicide among the medical population

Medicine is a noble and intense profession whose ideal is the preservation and improvement of human life. However, it has paradoxically become a high-risk activity for the individuals that perform it. Suicide rates among physicians exceed that of the general population[33,34]. One of the mentors of modern anesthesiology, dentist Horace Wells, was himself a suicide victim in 1848[35].

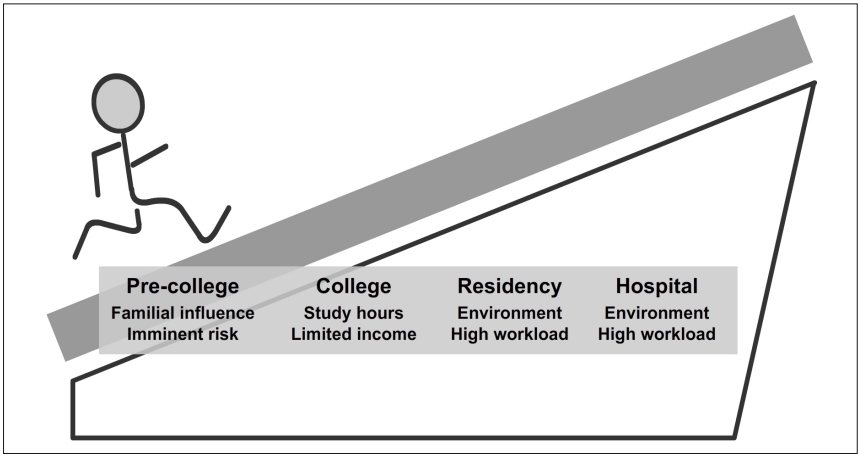
Like burnout syndrome, suicide is the result of a logical chain of events that starts with suicidal ideas and is followed by thoughts, plans, preparation and ultimately suicide attempt or death[36]. Suicidal tendencies vary among different professions: in England, from 1979-1980 and 1982-1983, the highest incidence of suicide was among physicians, veterinarians, pharmacists, dentists and farmers. After 2005, the suicide profile

changed dramatically, and the highest rates are currently among people who perform manual labor, showing the influence of economic forces in determining suicide[37].

Students that choose medical education after experiencing a disease themselves or in family members are under higher risk of developing burnout syndrome when compared to students who make their choice based on altruism, intellectual curiosity, professional autonomy and interest in human relations[38]. The complexity and length of the education process, combined with financial pressure, result in more medical students showing signs of exhaustion than trainees in any other areas of knowledge[39-42].

Studying medicine is a risky and expensive business, and many students need to work on the side to pay for university fees, which results in signs of exhaustion early in their professional lives. There is generally a combination of personal predisposition, that surfaces at university, and stressor factors that develop throughout an individual's professional life, which may culminate in severe consequences. (**Figure 1**)

FIGURE 1. The Burnout pathway



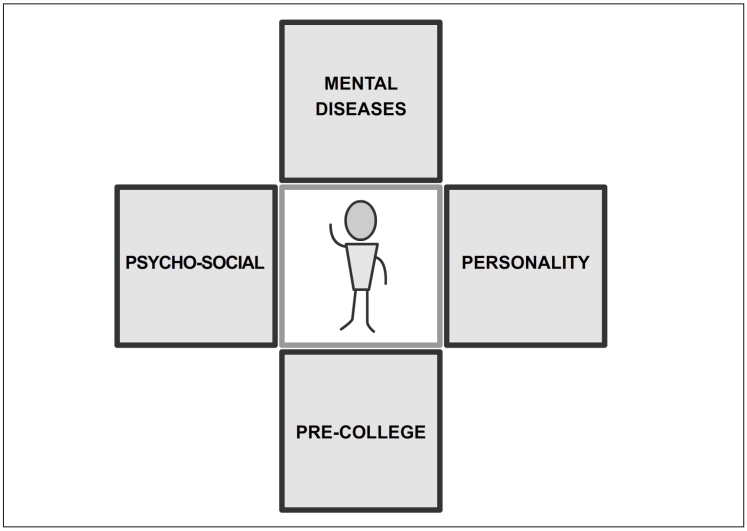
As illustrated above in the burnout pathway, from its beginning up until the possibility of fatal outcomes, there are several critical steps, and early recognition of the problem allows early intervention. The incidence of suicidal ideation during medical school varies from 10.7 to 31.4%[39-44], with higher suicide risk among women[45] and an upward trend in incidence over the years of medical life[41], but in general students are aware and in control of these thoughts. Students usually do not seek help for fear of judgment from family, society or university. During medical school, family influence acts as a protective factor, but as graduation and residency progress, physicians become immersed in the hospital environment and show increasing suicidal tendencies, as well as diminished insight about their thoughts and feelings. Furthermore, financial and personal expectations regarding the end of training and fear of being deemed unfit for a

specialist diploma cause physicians to avoid seeking help at this time. Also noteworthy is the ease in obtaining and using medications, which may lead doctors to explore their knowledge of effects, dosage and routes of administration in order to plan a painless death. The drugs most frequently used by suicidal physicians were barbiturates until 1995; since then, they have been superseded by opioids, especially among anesthesiologists[46]. Another important factor is that one in every 15 anesthesiologists suffers from drug or alcohol abuse, especially residents and department officers[47,48].

A 40-year chart review by Torre et al revealed that all causes of death occur with lower incidence in the medical population except for suicide. The risk of suicide is 70% higher than the general population among men and 250-400%[37] higher than the general population among women[49].

Susceptible physicians should be recognized and evaluated, since the origin of the phenomenon is multifactorial. Since all studies in this field are retrospective, there are still numerous gaps in knowledge about it. The presence of risk factors prior to university, such as mental illness, psychosocial issues and personality traits may shape the profile of the susceptible physician (**figure 2**)[50,51]. Mood swings and depression related to alcohol and drug abuse are issues that warrant consideration.

Figure 2. Suicide in the medical population and predisposing factors



Psychosocial factors such as occupational stress and existential conflicts can lead doctors to question their career choice, resulting in great anxiety, which requires support both in the family and in the workplace environments. Women are more susceptible to the work-*versus*-family conflict, since they often need to delegate the care of children and the household in the name of their profession. When this is combined with growing professional demands and shrinking salaries, the situation

may become unsustainable, leading to the abandonment of the profession in favor of family well-being.

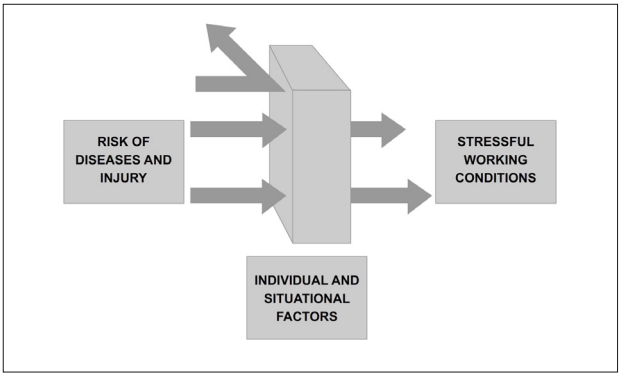
Anesthesiologists are at higher risk of death because they work under uncommon circumstances, such as exposure to anesthetic gas waste, ionizing radiation, extraneous bodily fluids, prescription drugs, stress, night shifts, long working hours and sleep deprivation. Alexander et al[52] analyzed data from more than 80000 deaths in an attempt to compare risks that anesthesiologists are exposed to with those of other medical specialties. There was no statistically significant difference in the rates of cancer and cardiovascular disease, but there was a significantly higher rate of suicide [relative risk (RR) = 1,45, confidence interval (CI) 95% = 1,07 – 1,97], drug abuse (RR 2,79, CI 95% 1,87 – 4,15), cerebrovascular disease (RR 1,39, CI 95% 1,08 – 1,79) and death from other causes (RR 1,53, CI 95% 1,05 – 2,22) among anesthesiologists.

The ability to solve problems that arise in his personal and professional life depends on the physician's personality – some personality traits augment the risk of suicide, such as obsessive-compulsiveness, self-blaming, introversion, anxiety and vulnerability[53]. Professionals who consider themselves self-sufficient and convey a self-confident image to the world but are aware of their conflicts and still do not seek for help are the most vulnerable to suicide.

Stress as a part of anesthesiology

In everyday society, people perform various tasks and professions which often expose them to occupational hazards. The National Institute for Occupational Safety and Health (NIOSH) is the U.S. federal agency responsible for research and recommendations for the prevention of work-related illnesses or injuries. This organization considers that characteristics of the work-worker relationship are the main cause of occupational stress – i.e., when the ability, resources and needs of the worker are not compatible with the work he performs[54]. The NIOSH proposed a model of how the factors leading to stress culminate in occupational injuries and illnesses. (**Figure 3**)

Figure 3. NIOSH occupational stress model



Some professions are, by the specific nature of the activity, more related to risks of occupational stress and risk of death:

- Sports: divers, paratroopers, boxers, wrestlers, bullfighters, climbers.
- Personal and industrial safety: guards, policemen.
- Transportation staff: drivers, pilots, technicians in aeronautics.
- Healthcare: doctors, nurses, especially when working in operating rooms, emergency rooms and intensive care.
- Administrative: managers, accountants, executives, stock exchange brokers.
- Industry: production line and construction workers.
- Various: activities requiring confinement such as workers at sea and military.

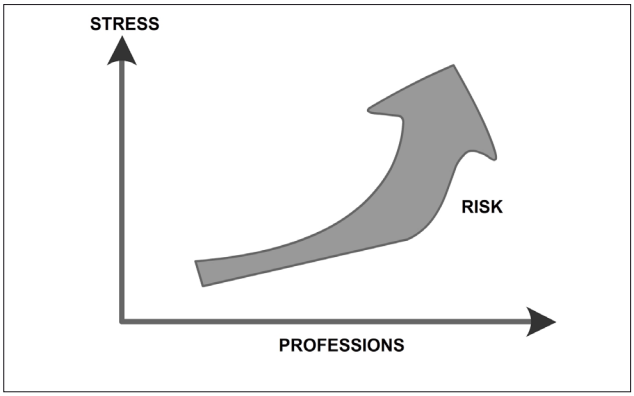
A person's professional choice depends on several factors, the most important being the affinity with the chosen profession, combined with ability, skill and identity to perform it. This choice is closely related to individual personality traits and way of working – some people identify with high expectation, high pressure professions; such individuals will perform worse and eventually even show signs of depression if placed in lower intensity roles. The allocation of employees according to personality traits is essential for companies, since performance levels can drop if an employee is unhappy and demotivated in his role.

The secretion of cortisol, catecholamines and other endogenous substances follows the circadian cycle, in the same way that professional activity varies throughout the day. There are times of day when, normally, hormone and catecholamine levels would be reduced, but occupational stress and the attentiveness required to perform certain tasks lead to further catecholamine discharge, in order to balance the natural cycle. This effect can also be achieved through the use of exogenous stimulants.

Stress is a necessary evil at certain times of an activity, in order to achieve the best possible performance, but if the intensity or duration of stress is excessive, the affected physician may suffer from reduced alertness and show signs of fatigue, which impacts negatively on his technical and non-technical skills. The moments of greatest stress for anesthesiologists are variable, but research shows that 5% of anesthesiologists are in conditions of constant stress[55,56]. The stressed doctor is not necessarily a bad doctor, but he may lose control in crisis situations[55].

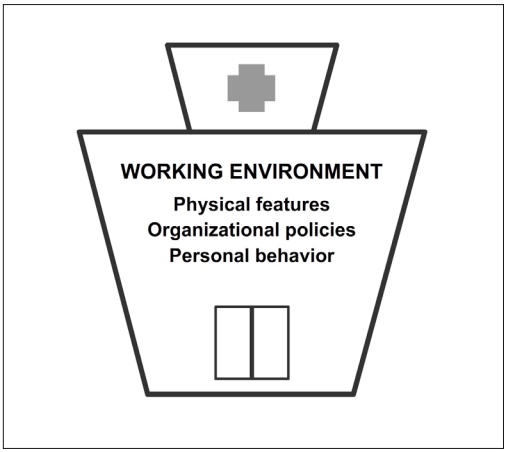
Any professional activity is subject to a certain level of stress, regardless of individual characteristics, but in some professions, even small daily activities entail levels of stress so high they cannot be compared to other professions. Professional stress levels are correlated to the degree of responsibility associated with the profession[57-62], and doctors performing surgical procedures are the most susceptible ones. Although all tasks must be performed responsibly, when there are lives at stake, be that of the professional or of the person receiving the service, the consequences of any action are undoubtedly more severe, and this must be taken into account in the study of fatigue. (**Figure 4**)

Figure 4. Occupational stress in the most susceptible professions



Awareness of the existence of higher degrees of occupational stress depending on the profession must lead to preventive measures against these consequences. This can be achieved through enhancing and updating information of professionals regarding the risks they are exposed to, through better time organization and distribution and through optimized teamwork in order to render the activity more efficient and less liable to mistakes. (**Figure 5**)

Figure 5. Stress and mitigating factors



Aircraft pilots are submitted to occupational risks similar to those of doctors: high demands in training, decision-making, attentiveness levels and efficiency. The performance of both professions poses significant occupational risks and they must therefore be waged accordingly (Table 2). Human resources and materials are necessary to support these professionals in the face of work-related stress, and it is crucial to build a suitable workplace environment.

Table 2. Anesthesiologists x Pilots

Issue	Analysis
Who saves more lives, physicians or pilots? [63 (60)]	Focus on both physicians' and pilots' missions in order to evaluate which profession has more lives under their responsibility. 75% responded that physicians save more lives.
Should pilots (61) and physicians have similar wages? [64]	There is awareness that both professions are related to risks, responsibilities and money. Medicine tends to be better compensated.
Pilots die, doctors don't [65 (62)]	The use of checklists in medicine, as exemplified by the ones employed by pilots, is suggested in order to reduce the incidence of human errors.
Who has the better job, pilots or doctors? [66(63)]	For safety reasons, the use of checklists is mandatory for pilots; it should also be that way in certain areas of medicine.
Pilots use checklists, why don't physicians use them?[67 (64)]	Training must be assessed individually and control evaluations must be undertaken in order to guarantee standard of care in both professions.
What can doctors learn from pilots? [68 (65)]	It is argued that pilots' wages are not compatible with the associated risks and responsibilities.
Who's more professional, pilots or doctors? [69 (66)]	Professional interest in ameliorating safety and quality of processes must be compared between pilots and physicians.

Shifts and stress

Hospital care is a continuous service that can be compared with other activities that require constant attention, 24 hours a day, such as power and fuel suppliers, military staff, policemen, firefighters, communications professionals, transportation staff, etc. Performing these activities requires physiological changes from professionals – light is the most potent synchronizer of the central nervous system (CNS), it reaches the retina and is transduced through the spinothalamic pathway to the suprachiasmatic nucleus of the hypothalamus, which governs the circadian cycle[70,71]. This allows the CNS to differentiate day from night in order to modulate hormone secretion, digestion, immunologic functions[72,73,50,51], mood, wakefulness and professional performance. Hospital-based healthcare professionals must be able to perform at any time of day, which means medical teams must work night shifts for which they are not physiologically prepared, since their CNS is programmed to reduce wakefulness and performance levels at night.

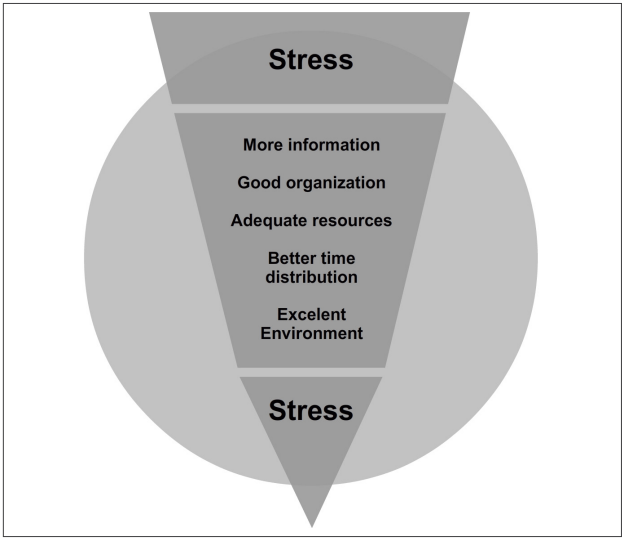
Due to the same reasons, car accidents occur most frequently at night. A study of 12535 accidents has shown that the majority of them included young drivers, fatigue (15%) and early morning hours, with no relation to alcohol use[74,75].

Night shifts cause physicians some anxiety related to possible threats and dangers on their way to work (Table 3) and, especially, the need to provide medical care at any time of day. These concerns trigger physiological changes such as decreased cardiac sympathetic modulation during the night, high levels of anxiety, depression and attention deficit[76]. This was shown by a follow-up study of three medical interns for three months as they worked 10 shifts per month of 33,5 hours, each shift followed by two days' rest.

There is currently concern over stress levels among anesthesiology residents, since the stress they experience may be greater than that experienced by their supervisors, possibly due to the heavy workload associated with worries about the progression of their practical and theoretical knowledge. Residency program supervisors are also heavily affected by stress; their leadership skills are tested daily in teaching, program management and clinical care activities[5]. Burnout syndrome consists of fatigue, impaired performance, emotional exhaustion and depersonalization, and is similarly frequent among residents and supervisors[77,78]. Because they are younger and in training, residents are presumed capable of tolerating heavier weekly workload, which, combined with alcohol intake and exhaustion, contributes to the development of burnout syndrome among anesthesiology trainees[79-81].

Physicians are very sensitive to their workplace environment, which means its psychosocial characteristics exert great influence over physician performance (**Figure 6**). These professionals tend to mirror their lives, self-esteem and satisfaction in their work, therefore inadequate management of work environment may result in dissatisfaction and possibly isolation of employees.

Figure 6. The workplace environment and its influence on burnout syndrome



Undoubtedly, a hospital is not an ideal workplace, since there are ongoing threats to the health of professionals (Table 3), such as: contact with terminally ill patients, accidents, suffering, death, unsuccessful treatments, responsibility to make decisions that will define their patients' quality of life. All these factors significantly impact physicians' lives; some are able to naturally mitigate these effects on their psychè, while others search for extraneous means of compensation to tolerate or better assimilate these adversities, the most common of which are smoking, alcohol and drug intake[82,83].

Table 3. Nosocomial threats to doctor's health.

THREATS	
Biological	Virus, bacteria, fluids.
Mechanical	Bruises, cuts, shocks.
Chemical	Vapors, gas, allergens.
Physical	Sounds, lights, temperature, x rays, laser, electricity, bad posture.
Personal	Drug abuse, fatigue, stress.

There are psychological conditions associated with a higher risk for burnout syndrome development among doctors, such as unrealistically high professional expectations, youth, being single and professionals with low self-esteem or who tend to victimize themselves over their colleagues. Rigid hierarchies, high pressure and excessive demands at the workplace are negative factors that can make the work environment another risk factor for burnout.

Doctors should have better working conditions, as work satisfaction affects patient-physician rapport and health care quality. Fatigue and quality of life affect professionals' attention and can be directly related to medical malpractice. Shanafelt et al coordinated a study with 7905 surgeons, 15% of whom acknowledged having committed significant malpractice; 70% of those attributed the error to a single factor, such as lack of time for proper decision-making, stress, burnout, lack of concentration or fatigue[84], thereby confirming that professional well-being must consider individual and organizational features.

A hospital provides more than just health care services to the population, it is a place where tutorials, teaching and learning activities are developed during the entire day. Fatigue and sleep deprivation exert negative impact on students' learning skills[85-89]. After a strenuous workload physicians' capacity to memorize and learn is compromised[90-92] so information will not be properly absorbed, creating a difficult situation where the teacher believes that all his words will be used in the treatment of patients but students have not actually absorbed the information. Classes and clinical discussion schedules can also affect learning skills, as human body is genetically pro-

grammed to sleep from 3 to 7 a.m. and from 1 to 4 p.m.,[93, 94] while it shows higher levels of vigilance from 9 to 11 a.m. and from 9 to 11 p.m. Physician's activities may be affected by fatigue, sleep disorders and changes in the circadian cycle and the only treatment for fatigue is to sleep.[95]

Outside the medical scope, the American Automobile Association (AAA) published in 2010 a report in which 27% of interviewed drivers admitted to having driven while they were somnolent, with difficulty to keep their eyes open, in the previous month; 41% of those fell asleep at some point; 10% of all the interviewed admitted to having slept while driving at least once during the previous year. [96]

The influence of exhaustion in driving capacity is similar to the influence of the highest legally allowed blood concentration of alcohol.[97] Fatigue and sleep deprivation can, therefore, affect driving skills by leading to lower levels of attention, vigilance and perception. In the case of health professionals, consecutive overnight shifts delay the capacity to analyze monitors[98] and there is a risky point where it does not matter how experienced the professional is, physical and mental fatigue will overcome the ability to sustain vigilance and the physician will lose control of the situation .

Critical situations experienced by anesthesiologists in the operating room can be compared to the situations experienced by pilots, considering human, economical and financial aspects. [52,63-69]

Errors, morals, ethics and the physician.

The practice of medicine is difficult and complex; the word error in this *milieu* creates profound impact with significant consequences. Medical malpractice is an act of imprudence, malpractice or negligence that causes severe or potentially severe consequences for the patient. It must be carefully analyzed by professionals with knowledge and expertise to be considered wrong, a medical malpractice.[99] Complications, preventable adverse events after medical treatment or surgical procedure whose risks were previously known, are not the same thing as medical error.[100-102]

Just as success, errors are the result of a sequence of events and any factor that influences the process will affect the result. When it comes to medical error, the patient's situation is the only concern, and physicians' physical and mental circumstances that may affect their judgment are not taken into account. In medicine not every error will lead to fatal or severe consequences, however, in some specialties such as anesthesiology and surgery errors are not allowed.

Kohn's report, dated from 1999, is used as a reference for medical errors. In this publication, approximately 100.000 patients died from complications that could have been avoided.[103] Studies reported that fatigue and sleep were the main causes of medical errors among residents.[103 -108]

For the practice of anesthesiology, physicians should be in their best physical, mental and emotional conditions in order to successfully integrate and apply all their

knowledge and practical skills. Fatigue, burnout, sleep deprivation and indifference to the patient make professionals more prone to errors. Residents and experts are aware that the number of overnight shifts, workload and hospital working conditions can be decisive factors in anesthesiologists' performance quality during critical situations. So it is necessary to analyze the reasons why anesthesiologists accept such heavy workload (institutional requirement, lack of organization, financial or personal reasons). In some institutions, overnight shifts are a way to increase employee income, so physicians overload their agenda at the expense of quality of medical care and life. Other doctors choose to work harder and have more overnight shifts not for financial reasons, but because of personality traits and lifestyle, in this case excessive work is just a part of their reality. Lack of institutional organization to optimize hospital's available resources contributes to greater emotional distress at work.

Thus, anesthesiologists should not work under inadequate physical, mental or organizational conditions, since professionals must have commitment and provide the best evidence-based treatment to the patient. Human life is considered an asset – Alfred Sauvy in his book entitled "The cost and value of human life"[110] (*Coût et valeur de la vie humaine)* reported life-related criteria considering social, religious, racial, political, economical and professional features. Excessive workload and great responsibilities can be negotiated in order to improve family life[111, 112] and patient's quality of care.

Conclusions

Human lives are saved every day thanks to developments in biomedical sciences. Anesthesiologists should always strive to expand their knowledge and to comprehend everything that happens to the patient. Studies in physics, chemistry and computer science, as well as leadership and hospital management knowledge, are important for the medical field. These sciences have been changing concepts and protocols to better guide clinicians. Usually doctors know more about their patients than about themselves, since they do not recognize occupational risks and do not perceive the latent fatigue caused by their duties and obligations. It is necessary to intervene and change the behavior of physicians and other healthcare staff in order to achieve better quality of life for these professionals and better quality and safety of care for their patients.

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Factors involved in the development of chemical dependency in anesthesia personnel

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The problem

For a variety of reasons, discussions concerning the possible use and abuse of pharmaceuticals by anesthesiologists and other medical professionals have been generally muted and restrained. Unfortunately the public is becoming aware of this problem through independent news sources over which the profession has little or no control[1, 2]. Obviously no profession wishes to draw negative attention to itself, especially in the view of the public or regulatory bodies. On the other hand, if a problem does exist, an intentional lack of attention may defeat the development of productive methods for intervening and treatment strategies. Therefore, as a first step, denial must be put aside and the question directly answered, do anesthesia practitioners have a problem? Decades of medical literature seem provide a definitive answer to this question.

An important study published in 1974[3], surveyed the causes of death for 211 anesthesiologists who were members of the American Society of Anesthesiologists living in the United States and Canada. This survey was simply part of an ongoing series of studies of a similar nature evaluating any aberrations in the causes of death among anesthesiologists[4, 5]. Not surprisingly, each survey had similar findings. Mortality for anesthesiologists, compared to a cohort of the general public, showed an overall reduced death rate in all categories, including cardiovascular disease, accidents and malignancies. However, when suicides were evaluated, anesthesiologists showed an alarming three-fold higher death rate than the normal population cohort. Deaths by drug overdoses were not separated from suicides. A more recent study[6], appearing in Anesthesiology, compared the mortality of anesthesiologists with a cohort of internists between 1979 and 1995. The results showed significantly higher levels of mortality for anesthesiologists in 4 different areas: 1) cerebral vascular accidents, 2) human immunodeficiency viral infections and viral hepatitis for male anesthesiologists; 3) suicide and 4) a 2 ½ higher death rate related to drugs. In regard to deaths due to drugs, anesthesiologists were at the greatest risk during the five years after medical school, but the rate of drug deaths in anesthesiologists continued to exceed internists throughout their careers. The conclusions of the study were: *"Substance abuse and suicide represent significant occupational hazards for anesthesiologists"*[6].

Aside from the personal tragedy from the loss of life, this study also points out the immense professional and economic toll produced by these deaths. Some 1,583 professional life **years** were lost due to suicide and 2,108 professional life **years** were lost

due to drug deaths. In one survey of United States anesthesia residency programs between 1997 and 2001, 80% of the programs experienced at least one resident having substance abuse problems and almost 20% experienced a death[7]. Certainly many other anecdotal reports exist for both anesthesiologists and nurse anesthetists having drug problems and higher suicide rates than the general public. It is a rare anesthesia practitioner who does not know of at least one colleague who has died from suicide or drugs. Getting a handle on the absolute percent of anesthesia practitioners affected by drug abuse is difficult and varies widely depending upon the study reviewed[8]. One report of physicians within a drug abuse treatment program found that while anesthesia residents made up only 4.6% of all residents in the United States, they accounted for over 33% of the physicians in treatment[9]. On the other hand another study found that the rate of anesthesia abuse among academic anesthesiologist was only 1% and for residents 1.6%[10]. (See **Table 1** for substances abused) Whatever the actual percentage, which may well vary from year to year, the loss of even one practitioner represents both a professional and personal tragedy. In addition to the drugs most commonly abused, one not listed is alcohol due to the legality of its consumption and difficulty in quantifying abuse. Never-the-less addiction to alcohol is also just as important as the other drugs, especially among the older population of anesthesiologists.

Table 1 – Raw numbers of practitioners abusing drugs and the drugs of choice for residents and faculty, as reported in an survey of anesthesia academic departments.

Drug	Number of residents	Number of faculty
Fentenyl	73	16
Sufentenil	12	4
Cocaine	7	2
Nitrous oxide	5	0
Meperidine	3	0
Midazolam	3	0
Diazepam	2	1
Ketamine	2	1
Halothane	2	0
Propofol	1	1
Other	23	9

(Date from: Booth JV, Grossman D, Moore J, et al; Substance abuse among physicians: a survey of academic anesthesiology programs; *Anesth Analg*; 2002; 95:1024–1030.)

The cited studies all arise from an evaluation of anesthesiologists in the United States and Canada. Therefore, it might be argued that suicide, drug dependence and burn-

out are only a problem isolated to North America. However, when one evaluates the International literature, these findings are universal among both anesthesiologists and other providers of anesthesia care. Finland has been a leader in pointing out the issue of suicide among anesthesiologists[11-13], though the discrimination between suicide and deaths due to inadvertent drug abuse overdose was not performed. In fact the lack of separation between intended suicide and drug overdose in drug dependent practitioners is typically not available in most retrospective mortality studies. Denmark and Sweden[14, 15] have also taken an interest in anesthesiologist's mortality. In Pakistan[16] these problems are being recognized in the general physician population, especially in women physicians. France[17], Canada[18], and Great Britain/Ireland[19] have each grabbled with these issues. The Canadian Medical Association has, as a result of recognizing this problem, developed an in-depth guide to physician well-being[18]. The list of countries officially recognizing that a problem exists within the ranks of their anesthesiologists also includes Australia/New Zealand[20], Brazil[21], and China[22]. In fact the problem of fatigue with burn-out contributing to physician drug addiction and suicide is finally being recognized across the world.

With such stark statistics, one might expect there would be a strident wake up call for all anesthesiologists throughout the world to take action. However, the recognition of these problems and the development of effective measures to alleviate the causes leading to these outcomes has been muted at best. The World Federation of Society of Anesthesiologists (WFSA) is now taking a leading role in drawing attention to these problems and ensuring both the health and safety of our **patients** through mechanisms to enhance the health and safety of our **anesthesia providers**[23] In 2010, the Professional Well-being Work Party of the WFSA conducted a survey of the 120 member societies within the WFSA aimed at identifying the incidence of occupational health problems amongst the member National Societies and asked each Society whether any interventions had been adopted by that National Society to address anesthesiologist's occupational health. Though the results showed wide recognition of a problem, with more than 90 % of the National Societies reporting the Burnout Syndrome in their members, only 14 % had developed any kind of coping strategy for this syndrome[23]. It is evident that the first step in attacking these problems is to discover the key factors that might cause an anesthesia practitioner to turn to substance abuse.

Genetic factors

Genetics during the past decade has become increasingly important to the anesthesia community for a variety of reasons. We now recognize a genetic connection to the development of malignant hyperthermia. Multiple genetic variations have been related to a predisposition for the triggering the onset of malignant hyperthermia with the most common genetic mutation occurring on the Type 1 Ryanodine (RYR1) gene of chromosome 19[24, 25]. Similarly, the occurrence of post-operative vomiting[26], renal failure[27], bleeding[28], and stroke[29] might each have a connection to

genetic variations. The effect of anesthetic agents on individual patients is in part modulated through genetic control. There are known differences in anesthesia sensitivity among mammals based on differences in genetic makeup. In particular a number of mice and rat studies have been performed showing that variations of a single gene produce significant differences in anesthetic and hemodynamic sensitivity to propofol[30, 31]. Differences in anesthetic sensitivity have also been seen with intravenous[32] and intrathecal fentanyl[33], as well as intravenous remifentanil[34]. Though contradictory information exists, it would seem that patients with red hair may have a recessive variation in the gene known as the melanocortin-1 receptor gene that could be related to anesthesia resistance and intraoperative awareness[35-37], though not all studies support this observation[38]. The key message is that the role of genomics in predicting a patient's response to a myriad of agents prior to giving these agents may well be on the horizon. In fact, as far back as 2003[39] an editorial about the use of genomics in anesthesia pointed out the direction anesthesiology was headed. The authors stated:

"Perioperative Genomics seeks to apply functional genomic approaches to reveal the biological reasons why similar patients can have significantly different clinical outcomes after surgery. For the perioperative physician, these findings may soon translate into prospective risk assessment incorporating genomic profiling of markers important in inflammatory, thrombotic, vascular, and neurologic responses to perioperative stress, with implications ranging from individualized additional preoperative testing and physiological optimization, to perioperative decision-making, options of monitoring approaches, and critical care resource utilization"[39] - However, the authors also pointed out the risks and ethical concerns associated with this new frontier.

Seeing the importance of genomics in the present and future delivery of anesthesia care, it should come as no surprise that genetics has an equally important role to play in preselecting anesthesia personnel at greater risk for developing substance abuse and dependency. A consensus seems to be developing that genetics may account for over 50% of an individual's predisposition toward the development of addiction to alcohol[40-43], while it may also play a significant role in addiction to both nicotine[44, 45] and other drugs[46, 47].

Genomics of Addiction based on Twin and Family Studies

The first indication of a possible genetic link for addiction came from comparative case-controlled population studies, and the findings from paternal and fraternal twin studies. The purpose of these studies was to determine the concordance of alcoholism in one twin with the occurrence rate of alcoholism in the other. If alcoholism was linked to genetic factors, the monozygotic twin sets might be expected to have a higher concordance rate than the dizygotic twins. The positive findings in this regard directed the consideration that there was the possibility of genes having a role in substance abuse[40, 48-50]. However, disagree-

ment continued to exist in regard to the relative importance of nature (genetics) verses nurture (environment) in the development of addiction[51]. At present the conclusion is that addiction stems from an interplay of both factors and that the more stable the environment, the less effect genetic predisposition has toward the development of addiction. The primary limitation in making definitive statements about the importance of genes and environment is that there are a multitude of variables that confound the picture that are directly relatable to the individual's environment, and to that individual's physical and psychosocial environments. Another method used for assessing the possible role for genes in addiction was the use of family studies. In these evaluations families identified with a number of addicted members from multiple generations have comparisons made between the addiction rate in the newest generation and estimations of genetic sharing of the same genome between generations[52, 53]. Once again environmental factors compound the difficulty for separating out purely genetic factors, but in spite of that difficulty a positive relationship was found pointing to a strong genetic link for addiction.

Animal studies also point to genetic involvement in predisposing toward addiction. Mutant mice with a single point mutation making the acetylcholine receptors exhibit increased sensitivity to nicotine, produced an elevated responsiveness to even low doses of nicotine and a tendency toward dependence[54]. This study provided evidence that for those individuals genetically predisposed to abusing a substance, even low level exposure could induce an addiction/dependence pattern. It is known that once a drug is abused, changes in the brain's physiology and biochemistry occur[55]. The genetic predisposition may be responsible for inducing these changes at an earlier time in life and with less drug exposure, which could explain why some individuals can abuse a drug without becoming addicted, while others become addicted almost immediately. However, many other factors are also at play, serving to either augment the chances of addiction or protect against addiction. More recent work on genetic variations in rodents is also beginning to uncover the reasons for differences in responsiveness to anesthetic agents[30, 31].

Genomics of Alcohol Addiction

The finding of a genetic link to addiction based on twin and family studies led to a major step forward in determining genetic predisposition to addiction - the search for the gene or genes causing addiction. Gene sequencing methods have greatly evolved and improved over the past decade, allowing research into the genetics of addiction to become more focused and illuminating. However, in spite of these improved methods for investigation, we are still at a nescient stage of discovery in this field. With improvements in technology and the ability to sequence the entire genome, there also occurs the increased difficulty in analyzing the huge amounts of data generated. Perhaps some of the clearest evidence

for a direct genetic link to substance abuse comes from research on the genetics of alcoholism[56, 57].

Approaches for studying the genetic link to alcohol addiction have taken a number of different directions. One approach based on the observed concurrence of addiction within families is to perform genetic analysis on family members with a high substance abuse rate and families that seem to be free of alcoholism. Performance of DNA analysis based on portions of the genome thought to be involved with addiction point to genetic variations that might increase the risk of addiction. As might be expected this needle in the haystack approach is challenging but has led to the identification of several variations in the genome that are more often found in people with addictions.

A similar approach has been taken on an individual basis where a single gene has been evaluated comparatively for groups of people with and without addiction, irrespective of family concurrency rates. As might be expected the difficulty in this approach has been the need to predetermine what genes to evaluate which are suspected to be related to addiction. The value of these studies seems to be greatest for genes involved in alcohol metabolism, which will be discussed below. Finally, more wide spread evaluations of the entire genome are being performed though all 3 billion nucleotides that make up the human genome are not tested. Rather, large sections of the genome are sequenced[58, 59] allowing for a more specific identification of genetic variations, called single nucleotide polymorphisms, that predispose the development of addiction. Based on these methods a many genetic sites have been located which seem to play a role in the development of addiction[56, 57]. For alcoholism alone multiple gene sites are involved, (See **Table 2**) both in a direct manner and indirectly through neurophysiologic traits[60]. In reality there may be as many as 100 or more genes that can influence the risk of addiction and it is the subtle interplay of these genetic variations in combination with environmental and other factors that ultimately determine an individuals' predisposition to addiction. Therefore there is no absolute that having a certain genetic variation will lead to addiction, only that that genetic subgroup might be at greater risk of addiction under certain circumstances. This is particularly important to point out when a genomic evaluation of every anesthesiologist is possible. Having a genetic predisposition to addiction is not the same as having the disease of addiction.

Table 2 – Some of the many genes involved in alcohol addiction. The complex interaction of many genetic traits in combination with other factors seems to be the primary determinant leading to one individual becoming addicted compared to another. The genes most strongly implicated in developing or protecting from alcoholism are those involved in alcohol metabolism - alcohol dehydrogenase and aldehyde dehydrogenase. To a lesser extent genes encoding for the neurotransmitter gamma-aminobutyric acid (GABA) and its receptors subunits are linked to alcoholism.

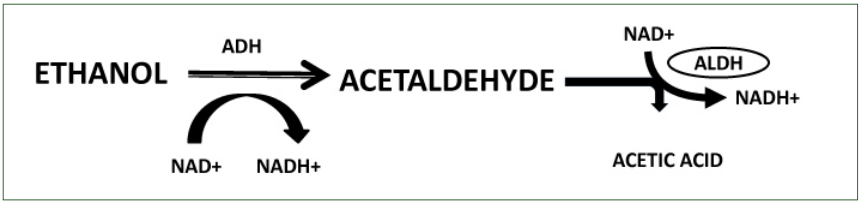
Some alleles linked to alcoholism
Alcohol metabolism genes – some are protective
ADH1B
ADH1B
ADH1A
ADH4
ADH1C
ADH5
ADH6
ADH17
ALDH2
Protein Encoding Genes
GABRA2
GABRG1
GABRA1
GABRG3
GABRR1
GABRR2
GABRR3

(Adapted from: Edenberg HJ; Genes contributing to the development of Alcoholism - An Overview; Alcohol Research: Current Reviews; 2012; 201; 336-338)

Genes in Alcohol Metabolism

As indicated in Table 2, there is a very close relationship between genetic variations in alcohol metabolism sequences and alcoholism. The two primary enzymes involved in alcohol metabolism are alcohol dehydrogenase (ADH) and aldehyde dehydrogenase (ALDH). The metabolism of alcohol is shown in Figure 1.

Figure 1 – Simplified schematic of ethanol metabolism. Ethanol is converted to an acetaldehyde, utilizing the enzyme alcohol dehydrogenase (ADH) in conjunction with the co-enzyme, nicotinamide adenine dinucleotide (NAD^+). The acetaldehyde is further oxidized to acetic acid with the help of the enzyme acetaldehyde dehydrogenase (ALDH).



The first step is the conversion of the alcohol molecule to an acetaldehyde through utilization of alcohol dehydrogenase (ADH) and coenzyme nicotinamide adenine dinucleotide (NAD^+). Further metabolism of the acetaldehyde occurs with its conversion to acetic acid utilizing the gene controlled enzyme NAD^+. The genes play a major role in this metabolic sequence and have a profound impact on protecting an individual from alcoholism. The majority of people have an allele called ADH1B which causes a slow conversion of alcohol to acetaldehyde but some population groups, such as Asians, as well as many individuals, have a variant allele called ADH1B*2 which increases the conversion rate, leading to a rapid increase in acetaldehyde. This variant allele is very common in people with East Asian ancestry and in the people of the Middle East[61-63].

The ADH1B*2 allele has also been found to occur in a much smaller percent of people from African and European ancestries, but as with the Asian populations, the individuals having the genetic variation showed a highly significant protective effect against the development of alcoholism[64]. The presence of the allele was not only associated with a lower amount of alcohol consumed, defined as the maximum number of drinks consumed in a 24-hour period, but also an overall decrease in the risk of developing alcohol dependence.

Most people utilize a type of ALDH called ALDH2 to metabolize the acetaldehyde to acetic acid in a rapid and efficient manner. However, in certain populations such as Asians, a variant allele of the normal acetaldehyde dehydrogenase (ALDH2) gene, called ALDH2*2 is produced which is only 8% as efficient as ALDH2 in converting acetaldehyde to acetic acid. In fact some 50-70% of the Japanese population has this genetic variation but it is also found in European and African populations, though much less commonly[63, 65]. Of interest in one study of alcoholic Chinese men only 12% had the ALDH2*2 allele, while 48% of non-alcoholic Chinese men had the variant and protective allele[66].

Acetaldehyde is toxic to humans so that for individuals with the ADH1B*2 and ALDH2*2 alleles, the effect of drinking alcohol is to produce high serum levels of acetaldehyde which in turn produces the "flush syndrome," where the face becomes flushed, and the unpleasant symptoms of nausea, vomiting, palpitations, and headaches occur[63]. These symptoms serve to protect the individual from alcoholism since they negatively reinforce the use of alcohol. In fact a similar effect is produced with the anti-alcoholism drug, Antabuse, which produces a rapid elevation of acetaldehyde on consumption of alcohol. Of interest, these genetic predispositions protecting against alcoholism can be overcome by social influences for individuals with a single ALDH2*2 allele in their genome[62]. However, when the individual has two ALDH2*2 alleles, the chances of becoming alcoholic are virtually zero, due the severe adverse systemic effects of the un-metabolized acetaldehyde.

Though ADH1B*2 and ALDH2*2 alleles are the primary genetic variants that have been found to effect alcoholism in a protective manner, other variants are also felt to

possibly play a lesser role. Most of these genetic variations occur in the genes closed associated with the ADH and ALDH genes and are thought to primarily function by altering the active expression of these genes, rather than by having an independent direct effect. Some of the genes related to having such activity are ADH4, ADH1C, ADH5, ADH6, and ADH7. Interestingly, unlike the ADH1B*2 and ALDH2*2 alleles, these genetic variations are linked to a predisposition for the development of alcohol dependence[67-69].

Genes Effecting Alcoholism through Protein Encoding

Though some genes affecting the metabolism of alcohol have a major effect on the risk of developing alcoholism, other genetic variations encoding for subunits of the neuro-receptors that respond to the neurotransmitter, γ-aminobutyric acid (GABA), have also been implicated in having a role in the risk for alcoholism and other addictions[70-74]. The list of the GABA gene variants that have been associated with addictions are listed in **table 2**. Part of the difficulty in determining whether a genetic variation is protective or places an individual at increased risk for addiction is confounded by the observation that the GABA receptors may undergo changes in the addicted patient – both molecularly and in physiological response.

Other neurotransmitter systems have also been implicated in addiction, including dopamine, serotonin, and acetylcholine, but the involvements are complex and not clear at this time. For instance it is known that dopamine, serving as a neurotransmitter within the limbic system, is active in reinforcing addictive behaviors due to the effect on the pleasure centers of the brain. Nicotine seeking behavior in mice is augmented when a subunit of the limbic nicotinic acetylcholine receptor is present but the drug seeking behavior is absent when a genetic variant causes the absence of that subunit on the dopaminergic neuron. In humans a variation in a cholinergic muscarinic receptor is involved in memory and cognition, can also increase the risk of alcoholism, as well as other drug dependencies and psychiatric disorders[75-79].

Genomics of Opiate and Other Drug Addictions

Though the evidence of a genetic link to addiction is very strong for alcohol, there is mounting evidence that other substance addictions also have a strong genetic predisposition. For opioids, as with alcohol, twin studies has been performed to provide indirect evidence for a genetic link to narcotic addiction. The premise of one study[80] was based on the observation that some of the side effects of narcotics are unpleasant. Patients who were genetically similar, such as twins, might be expected to have similar concordance in their side effects. In addition individuals who perceived the effect of an opioid as a negative experience might well be protected against the development of an addiction, in a manner similar to the avoidance of alcohol for those having the ADH1B*2 and ALDH2*2 alleles. The study findings were somewhat cloudy in that not only did significant heritability exist for the side effects of respiratory depression (30%), nausea (59%), and drug dislike (36%), they also found that

familial factors played a role in the side effects of sedation (29%) pruritus (38%), and drug liking (26%). The overall conclusions of the authors[80] and the editor[81] were that genetics did affect the response of individuals to opioids but that environment and demographics factors also played a key role. Genetic factors could account for as much as 50% of the observed opiate mediated nausea and this adverse effect might well be protective against the development of an opioid addiction. Others studies also support a genetic role in the predisposition for the development of opiate drug addiction[82, 83]. The actual genes involved in opioid responses are show in **Table 3**, though the correlation of these gene variants with a predisposition to developing a opioid addiction are not as strong as the genetic link found with alcoholism.

Table 3 – Some of the genes thought to play a role in opioid addiction. Multiple factors including environmental and demographics interact with the genetic factors in a complex and at present obscure manner to produce the undesirable predilection for narcotic addiction.

Genes Possibly Involved In Opiate Responses
OPRM1 – Strongest Association - MU Receptor Modulation
UGT2B7
ABCB1 – P-Glycoprotein Gene
HTR3B
COMT
POMC
OPRK1 – Also Associated With Alcohol Addiction – Kappa Modulation

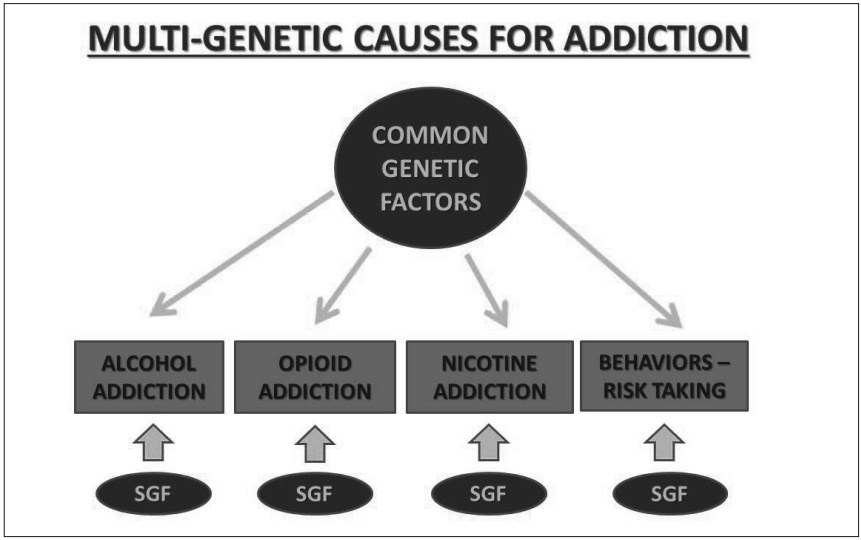
The OPRM1 gene encodes the G protein-coupled mu opioid receptor which in turn is the primary target for all the opiates. Variations in this gene are thought to be responsible, at least in part, for observed individual variations in opiate dependence and responsiveness[83]. The importance of OPRM1 polymorphism in regard to the synergistic relationship of propofol used with the narcotic remifentanil for anesthesia was explored in a group of patients undergoing sedation for endoscopy[84].

The important findings were that patients with a single nucleotide polymorphism (A118G) in the mu 1 receptor gene (OPRM1) were not able to show a synergistic response to remifentanil when it was added to a propofol infusion. In addition to the importance of the mu receptor modulation in opioid's effects, the genetic modulation of the kappa opioid receptor may also play an important part in the genetics of opiate responsiveness and addiction. The kappa opioid receptors are found in the dopaminergic neuronal limbic system, which serve as the pleasure reinforcement centers of the brain. As indicated previously, this system may be involved in the risk for alcohol addiction also. However, the importance of this system and the kappa receptor is not obvious at this time and requires further study to elucidate its importance. In addition addiction to cocaine and propofol may well be linked to genetic variations affecting this system.

General Genetic Overview

As scientific evidence continues to accumulate, the importance of genetics in predisposing any individual to substance abuse cannot be minimized. Obviously, non-genetic factors distort some of these studies, but overall, genetics is increasingly considered to play a significant role. The whole study of genetic factors in addiction is still in its infancy, but research is pointing to a defined genetic predisposition for many individuals. In fact as much as 50% of an individual's predisposition to becoming addicted to a substance is predicated upon genetic factors. However, it must be stressed from the onset that genetic predisposition is not a direct causative factor for developing addiction. Simply put, genetics by itself is only an important modifier that can either increase or decrease the chances of an individual becoming addicted. Genetics is not an absolute in regard to whether certain genes will completely protect one or cause one to turn to drugs. In spite of this uncertainty, as more information on the importance of genetics in predisposing to addiction accumulates, there will be increasing calls that all medical personnel be checked prior to acceptance in professional schools to "redirect" the choice of specialty for those predisposed to addiction to lower risk professions.

Figure 2 – There are common genetic factors, as well as specific genetic factors (SGF) that influence addiction to each substance. Along with the genetic factors there is substantial modification of the genetic influences by environmental and demographic factors.



(Adapted from: Edwards AC, Svikis DS, Pickens RW, Dick DM; Genetic Influences on Addiction; *Primary Psychiatry*; 2009; 16:40-46)

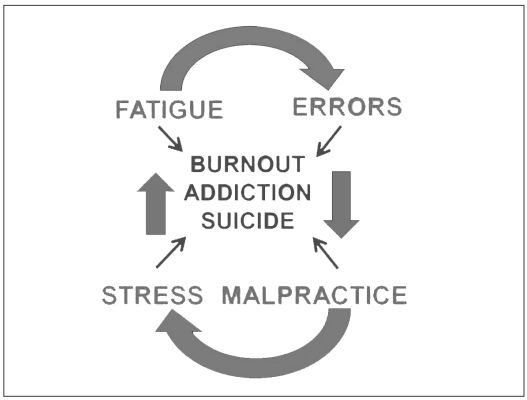
Also, with our rudimentary understanding of the genetics of addiction begins to solidify, one model that seems to make sense is shown in **Figure 2**, which is adapted from a paper by Edwards[85]. This schematic crudely indicates our present understanding

concerning how genes play a role in the development of addiction. There are common major genetic factors which predispose to all sorts of addictive behaviors and the genetic codes that provide this generalized predisposition seem to exist near the alleles that also predispose an individual to be a risk taker. In addition secondary genetic variables work in concert with the main genetic variant to predispose toward specific addictions, such things as alcohol, opioids, and nicotine. The specific genetic factors (SGF) either affect the metabolism of the target substance of affect how the substance interacts with the end-receptor. Finally, it must be emphasized that aside from genetic predisposition, other factors are important in leading any particular person into drug abuse and addiction. Genetic factors may be 50% of the causative predisposition, but the other 50% is directly attributable to the ability to cope and endure the many stresses found in that individual's environment. In the case of the practicing anesthesiologist, these stressors are common to the professional workplace – the modern operating room.

Professional stress factors – the vicious cycle

There is a vicious cycle encountered in routine anesthesia practice that tends to tear down coping mechanisms and increase the chances that an anesthesiologist might turn to misuse of a substance in order to cope with the stresses. The cycle typically starts with physical fatigue, which seems an integral part of modern anesthesia practice. Fatigue leads to medical errors, which in turn, through self-recrimination and/or a malpractice suit, leads to stress and increased emotional fatigue. (see **Figure 3**) Any one of these factors can lead to an anesthesiologist looking for a way to relieve stress. With the availability of drugs, one avenue that is unfortunately selected all too often is drug abuse, which in turn leads to a spiral of addiction. The role of each of these factors will be discussed individually.

Figure 3 – Fatigue leads to the increased risk of making a medical error. Medical errors lead to a high stress state and can result in medical malpractice law suits, which also produces high stress. Stress causes emotional fatigue and predisposes to the making of more errors. Without proper support and coping mechanisms in place to break this cycle, the dysfunctional reaction of the anesthesiologist may be substance abuse, burnout, or suicide.



Fatigue

Fatigue for the anesthesiologist can be physical, mental or emotional in origin. It is not infrequently that all three play a major role causing burnout syndrome. Though the vicious cycle of fatigue, medical error, malpractice and stress can be entered at any point, the most common origin into this cycle is fatigue. In the past decade the role of fatigue in causing human error during the provision of healthcare has become increasingly recognized. In the United States concern that overworked medical residents might cause serious patient injury and even death was responsible for the Accreditation Council on Graduate Medical Education putting into place stringent limitations on resident work hours in 2003. Since 2003 the standards for resident duty hours have been refined and key elements as of July 2011 are shown in **Table 4**[86].

Though regulatory curtailments of work hours for resident training are being put into place, the same is not occurring for experienced anesthesiologists. The lack of work rules for the practicing anesthesiologist becomes of even greater concern when viewed in the context of the larger numbers of older anesthesiologists that continue to actively practice. An excellent review of fatigue in anesthesia points out the risk of fatigue in the specialty of anesthesiology is based on not only a **lack of sleep** but also a disruption of the **circadian rhythm** when shift work changes between day and night[87].

Table 4 – Elements in the Accreditation Council on Graduate Medical Education restrictions on medical resident duty hours. Additional rules provide modifications of these rules based on year of residency. Effective: July 1, 2011

ACGME standards for resident work rules
1) maximum hours of work a week – 80 hours averaged over 4 weeks
2) moonlighting work – counts toward the 80 hour maximum
3) at least one duty free day a week
4) maximum duty period should not exceed 16 hours for first year
5) maximum duty period is 24 hours for second year and above
6) minimum of 8 hours free of duty between duty periods
7) in house call no more frequent than every third night

(Adapted from: http://www.acgme.org/acgmeweb/tabid/271/GraduateMedicalEducation/DutyHours.aspx)

Fatigue and a Lack of Sleep

Documentation of the adverse effect that a lack of sleep has on performance is widespread in both the medical[88-90] and industrial literature[91, 92]. The primary concerns surrounding fatigue's effect on performance is it presents impairment of vigilance and reaction time, which are both central to the provision of safe anesthesia care[93, 94]. Though safe anesthesia demands continuous alertness and attention with the ability to rapidly react if problems arise, fatigue undermines not only the reaction time but also the ability to maintain an attitude of alertness[95,96].

Though the operating room environment is usually quiet and the patients are usually stable, this works against the fatigued anesthesiologist by allowing the development of a false sense of security and a lowering of alertness. When a problem arises, fatigue intervenes in slow the recognition that a problem exists and slow the responses needed to correct the problem. When sleep deprived anesthesiologists were compared to rested anesthesiologist during a patient care simulator over 4 hours, there were striking reductions in psychomotor performance, mood and level of alertness in the sleep deprived subjects[97].

One study compared neurobehavioral performance in groups of residents after having a hard workload night of being on-call, after a light workload night on call, and after alcohol ingestion[98]. The not surprising findings were that a heavy night on call produced the same impairment in performance as having a 0.05% blood alcohol level. Similarly, others have found the same blood alcohol level of 0.05% was equivalent to 17 hours without sleep for simple performance measurements of hand-eye tracking. If sleep deprivation was extended to 24 hours, the impairment was equivalent to a blood alcohol level of 0.1%[99]. While careers of anesthesiologists have been significantly compromised from the discovery of a blood alcohol level equivalent to those found in these studies, no similar concern has yet been taken in regard to protecting a patent from care provided by a practitioner who has been working continuously for over 24 hours.

For the older anesthesiologist, the challenge of sleep deprivation and fatigue on their clinical performance may be compounded. One study of anesthesiologists over 65 years old concerning the incidence of malpractice law suits would indicate the older anesthesiologist is at particularly greater risk of being sued[100]. The causative factors were not elucidated but there was a suggestion that some of the same performance detriments that occur with fatigue may also play a role during the aging process. Compounding these naturally occurring effects with the additional detriment of fatigue might be a cause of increased concern for the practicing elderly anesthesiologist. In fact self-recognized stress from being required to participate in night call was a primary factor for many elderly anesthesiologists deciding to retire[101,102].

Fatigue and the Circadian Rhythm

Fatigue is not only caused by a lack of sleep but also by a disruption of the normal circadian awake/sleep cycle. Since most anesthesiologists take call at night, disruption of the normal circadian rhythm is nearly assured. The circadian rhythm is an internal cycle modulated by the hypothalamic suprachiasmatic nucleus which is in turn directly affected by secretions of melatonin from the pineal gland. Melatonin secretion is stimulated by light and suppressed by darkness which is how the synchronization between the circadian rhythm and the day/night cycle occurs. The circadian system keeps the body's biochemical, physiological, and behavioral processes on an approximately 24 hour cycle. Such parameters as body temperature and blood pressure change during a 24 hour period based on the circadian cycle. In individuals with a normal wake-sleep

cycle the circadian rhythm allows the individual to anticipate hormonally and physiologically regular environmental changes. However, changing the timing of the sleep wake cycle in the face of an established circadian rhythm, which occurs for anesthesiologists when they periodically perform night call duties, can be detrimental to the body's normal function and the ability to provide the best patient care. The reason that disruption of the circadian cycle is important for concerns about an anesthesiologist fatigue, is that when the cycle is usually at its lowest between 2 and 4 AM, alertness and performance are also at their lowest[103]. Sleepiness which is also governed by the circadian rhythm is at its peak at night from 1 – 7 am and in the early afternoon. The cycle may be the cause for observed diminution in the ability of emergency room physicians to rapidly and effectively intubate patients during the night compared to the day[104,105]. Similarly, the placement of epidural catheters by anesthesia personnel resulted in more dural punctures at night after midnight than during the day[106]. Therefore, physicians changing from a day shift to a night shift encounter a form of "jet lag" that can have significant adverse effects on their psychophysiological performance with particular emphasis for anesthesiologists' alertness and vigilance.

In regard to substance abuse by anesthesiologists, the circadian cycle seems to have significant involvement with the timing of drug seeking behavior. During certain portions of the circadian cycle, alcohol and drug use increases. Not only is alcohol consumption modulated by the time of day based on the circadian rhythm[107], the use of alcohol has been observed to increase in individuals whose circadian rhythm has been disrupted by rotational shift work or time-zone changing travel[108,109]. At the same time that alcohol and other drug use is modulated by the circadian cycle, drugs also have a direct effect on the normal circadian by suppressing plasma corticosterone levels through the interruption of the function of the hypothalamic pituitary axis. The effect of alcohol and drugs on this axis is thought to be mediated through so called "clock genes" which regulate the circadian cycle[110,111]. The "clock genes" may also be critical for controlling the propensity to consume alcohol to relieve stress[112, 113]. Similarly, opioids and cocaine also have direct effects on stress relief[114-117]. Therefore, the normal stress responses, which are exaggerated during certain times of the circadian cycle or when the cycle is disrupted, are relieved in part by the use of alcohol and drugs. The reduction in stress associated with substance abuse serves as a positive reinforcement which further stimulates drug seeking behavior and further disrupts the normal circadian rhythm. For the fatigued anesthesiologist already having a disrupted circadian cycle due to changing day/night shifts and who encounters additional stressors while providing anesthesia care, turning to substance abuse can be the maladaptive mechanism for stress relief.

Fatigue and Medical Errors

The association between fatigue in anesthesiologists and the chance of that anesthesiologist making an error in judgment or practice is firmly established with as many as 50% of surveyed anesthesiologists admitting that they were responsible for

making a medical error when fatigued[118-121]. The recognition of the high risk of making an error while fatigued has led national anesthesia societies across the globe to make specific recommendations for ways to reduce anesthesia provider fatigue and resultant patient harm that stems from that fatigue. The United States[122], Australia and New Zealand[20], Canada[18], as well as Great Britain and Ireland[123] have been leaders both in recognizing the problem and in attempting to deal with it. However, since the implementation of mechanisms to avoid practitioner fatigue usually occurs at a local level, penetrance of the recommendations has been variable. Concern about the potential harm to patients led the Anesthesia Patient Safety Foundation to devote an entire Newsletter to different aspects of this problem[124].

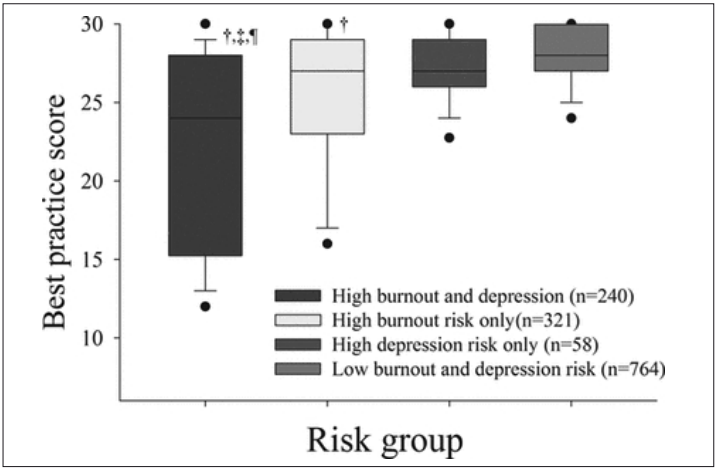
Of particular concern is fatigue in residency training programs, since even with reduced work hour rules, sleep deprivation is common in many internships and residencies[125]. Not only is there a loss of cognitive function with the loss of sleep for a single 24 hour period but there is also a cumulative effect with longer term partial sleep deprivation[126-128]. Of major concern for anesthesiologists is that one of the most important impairments accompanying fatigue from sleep loss was vigilance. A loss of vigilance in anesthesia translates into medical errors and potential patient harm. In one study of 380 internal medical residents, there was a direct association found between the self-recognition that fatigue existed and the making of major medical errors[89]. In addition the same study found that a resident's self-recognition of emotional distress was an independent factor associated with the occurrence of a major medical error. Emotional distress is common when a resident makes a medical error[129] and therefore an internal vicious cycle is produced whereby an error made because of fatigue leads to distress which in turn increases the chances that another error will be made. The end result is a high stress level, depression and burnout - all of which can lead to drug addiction or suicide for relief of the resultant stress.

Fatigue and Burnout

The concept of burnout which was originally used to describe drug users who had basically reached the bottom of their addiction, has been expanded to include working individuals who have adversely responded to chronic job related emotional and interpersonal stresses[130,131]. The three primary dimensions which define burnout are exhaustion, cynicism, and professional ineffectiveness. The key element leading to burnout and the one which is considered most important is a state of exhaustion, which occurs at a physical, emotional and mental level[132]. It is the combination of work load and emotional demands on the job that serve as the major stressors leading to burnout[131]. These same stressors have also been linked to various forms of drug abuse and addiction. Of significance, younger adult populations below 30 years of age seem to be at a higher risk for burnout compared to the more elderly workers[131]. Therefore, it is not surprising to find a high rate of burnout and suicidal ideation in the highly stressed medical student population[133]. Among anesthesia practitioners, it is the interns, resident, and newly graduated anesthesiologists that are most likely

to become burned out and turn to drugs as a coping mechanism. This finding was substantiated by a survey completed by 1508 United States anesthesia trainees[134]. 41% of the anesthesia trainees were found to be at high risk of burnout. In addition the factors that seemed to be mostly closely correlated with burnout risk were being female, working over 70 hours a week, and drinking more than 5 alcoholic drinks a week. Of great concern for patient safety was the finding that 33% with high burnout scores also admitted to multiple errors in giving medication as opposed to those trainees with low burnout scores that had only a 0.7% medication error rate[134]. The risk of a medical error by our surgical colleagues is also increased when they are in an exhausted, burned out state[135]. As previously indicated, making a medical error by itself causes significant stress and fatigue which then can predispose to further medical errors being made. A comparison of trainees that utilized the "best practices," when giving anesthesia based on questions concerning if they followed anesthesia standards of care, showed a significant inverse correlation between the anesthesia trainees with high burnout scores and their "best practice" scores. (see **Figure 4**)

Figure 4 – Anesthesia trainees who had the highest burnout scores also had the lowest scores indicating that they followed best practice standards.



(Figure taken from: De Oliveira GS, Chang R, Fitzgerald PC, et al; The prevalence of burnout and depression and their association with adherence to safety and practice standards: A survey of United States Anesthesiology Trainees; *Anesth Analg*; 2013; 117:182-193.)

In spite of some protection from burnout with age, all physicians seem to be at risk of burnout[136] with an estimated 35% of all practicing physicians showing signs of burnout[137]. One group of senior anesthesiologists seems to be at special risk for burnout and that is academic chairpersons. A survey of 93 academic chairs, only 32% reported a high job satisfaction rating while 28% met the criteria for high burnout and another 31% were moderately burned out[138]. Of interest 28% also indicated that they were planning on stepping down as chair within the following year or two. Such

findings indicate a crisis in anesthesiology leadership. The health of the profession depends on finding way to help all anesthesiologists cope with increasingly difficult working conditions. Certainly alternative, constructive approaches for emotionally coping with job stresses must be found to prevent our colleagues from taking the maladjusted approaches of substance abuse and suicide[139].

Medical Errors

When a new physician takes the Hippocratic Oath it quite clear that a primary concern when caring for a patient is to do no harm. The Oath states: "By Apollo the physician … I will keep this Oath. I will follow that system of regimen which, according to my ability and judgment, I consider for the benefit of my patients, and abstain from whatever is deleterious and mischievous."

As physicians, the concept of doing no harm has evolved into a self-imposed level of perfectionism that does not tolerate mistakes or errors. Of course "to err is human" and by taking on the mantle of error free perfectionism, a physician has adopted a philosophy which is bound to fail. Striving for perfectionism is a noble goal and one that the public expects. Achieving perfectionism is virtually impossible in spite of the public's expectation. Provision of anesthesia care by its very nature is based on a combination of art and science. The huge clinical variability in one patient's response to a drug or intervention cannot always be predicted and there is a time in every anesthesiologist's career that an incorrect prediction will be made and patient harm will result. For the physician who only wants the best for his patient, making such an error is one of the greatest stressors he will encounter in life. The stress is compounded if the anesthesiologist realizes that the error was his fault due to fatigue or due to having overlooked an obvious piece of information. When this occurs the physician must face the reality that he is not perfect, which undermines his self-image of immunity from error, and can be devastating to his self-confidence. In fact the physician who is the most self-critical and has the highest personal standards may be at particularly high risk from the consequences of making an error[140].

The loss of self-image may destroy the very basis upon which the physician practices and even lead to the physician abandoning clinical care. Therefore it is not surprising that this situation has been labeled "The Second Victim" syndrome[141]. The primary victim is the patient but significant suffering also occurs for the physician. In attempting to cope with his own suffering and guilt the physician may well turn to alcohol or other substances, and eventually even to suicide. In fact drug abuse and alcoholism under circumstances of increased stress or depression following the occurrence of a medical error may well be the nuclear cause of the increased suicide rate for all physicians but also anesthesiologists specifically[142].

The physician that takes the route to substance abuse and suicide will often do so if there is no other avenue that is seen open to help cope with the medical error. Having empathetic and understanding colleagues who can discuss the error in a non-

accusatory and professional manner goes a long way in helping the physician committing an error be able to deal with the mistake. The intervention with colleagues is especially helpful if discussions are centered on ways to learn from their error and how to prevent similar errors in the future[140].

By taking positive steps toward attacking the error, the inward turning of self-accusation and recrimination can be muted. However, in spite of recommendations for an immediate debriefing following an intraoperative catastrophe[143], there is little scientific evidence supporting a requirement for such intervention[144,145]. The lack of firm evidence of the long term benefit of a debriefing should not prevent such counseling since it does allow venting of anxiety, anger and concerns that could be potentially crippling[146].

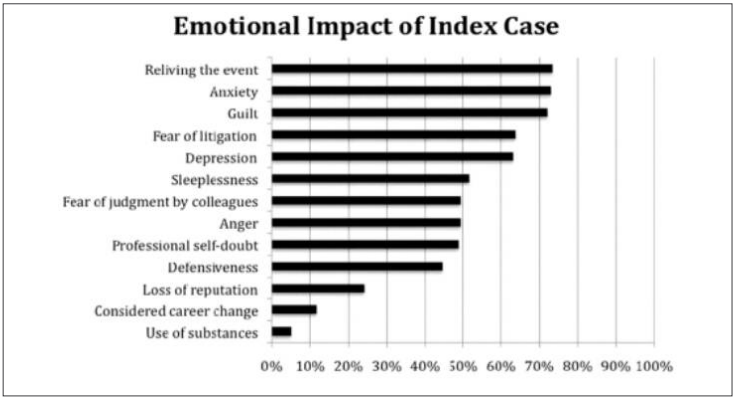
As important as having open discussions with one's colleagues is having a face to face talk with the harmed patient or the patient's family. Perhaps a talk with the patient or family is one of the most emotionally difficult times a physician may have to endure. Physicians often feel that exposing their mistake will not only lessen their stature in the eyes of the patient but will increase their risk of a malpractice suit. Quite the contrary and counter-intuitively, a malpractice suit is far more likely when the physician avoids the patient and family, since he will be viewed as aloof and uncaring. In addition by openly admitting error, both to himself and to the patient, the physician achieves a catharsis of guilt that is otherwise difficult to attain. Without the absolution of open discussion and the inward acceptance of having made an error, the sensitive and reflective physicians may find dysfunctional ways of dealing with their guilt, such as substance abuse and suicide[141].

The emotional consequences of a physician making a medical error are unexpectedly long lasting and deep. Evidence of the link between making a medical error and the development of emotional and professional repercussions for anesthesiologists was reported in a survey of the attitudes of 300 anesthetists in England, after experiencing an intraoperative death[147]. From the 251 anesthesiologists that replied some 92% had experienced an intraoperative death. Though the majority of these deaths were expected and not preventable, many of the anesthesiologists still felt high stress levels. In spite of the stress, they immediately continued to provide anesthesia care to other patients. The continuation of clinical services was in spite of over 10% of them feeling that their professional abilities had been compromised by the experience. In addition some 35% indicated a feeling of personal responsibility for the death.

The survey revealed that while 71 % of the anesthesiologists thought that it would be prudent to for a practitioner to delay the provision of care to other patients for 24 hours after an intra-operative death, that in reality less than 25% actually followed this practice. The conclusion of the study was that the loss of a patient intra-operatively, whether expected or not, was a highly stressful event for many anesthesiologists and consideration should be given to the provision of psychological support and the discontinuation of further operations for those psychologically traumatized[147].

Another survey of 1600 British and Irish anesthesiologists[148] found similar results. 40% of the anesthesiologists whom had an intraoperative catastrophe had a sense of personal responsibility, which was compounded if an error in judgment was felt to have contributed to the catastrophe. 24% felt that it took them days to recover but of major concern, some 7 % had feelings of guilt for years and 1% even considered leaving the specialty of anesthesiology. A more recent survey of the impact of perioperative catastrophes on anesthesiologists in the United States provides further evidence of the long term and profound emotional impact that an untoward event can produce[149]. 1200 randomly selected members of the American Society of Anesthesiologists were sent a survey with a 56% completion rate. Of the responders 84% had been involved in at least one catastrophic intra-operative event, usually an unanticipated death or serious injury. More than 70% relived the event with the feelings of guilt and anxiety. (see **Figure 5**)

Figure 5 - The adjusted percentage of anesthesiologists showing the emotional impact to an intra-operative catastrophe.

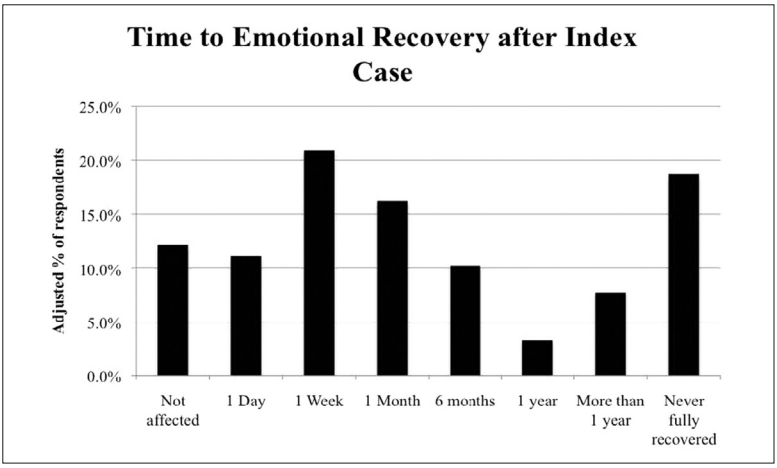


(Figure taken from: Gazoni FM, Amato PE, Malik ZM Durieux ME; The Impact of Perioperative Catastrophes on Anesthesiologists: Results of a National Survey; *Anesth Anal;* 2012; 114:596-603)

To a lesser extent the stress of having an adverse experience led to depression, sleeplessness and a fear of the possibly of being sued. Of great concern is that over 10% of the respondents considered changing careers and 5% turned to substance abuse to help them cope. The conclusions are dramatic; the occurrence of a major adverse intraoperative event takes a devastating toll on the anesthesiologist. However, not only is there an immediate impact from experiencing an intra-operative catastrophe, but the emotional aftermath for many anesthesiologists is long lasting[149, 150]. Emotional "recovery" was most frequently stated to be one week, though some 12% declared that they were not at all emotionally affected. (see **Figure 6**) On the other end of the scale, 19% of the respondents indicated that they never fully recovered. Put into perspective one out of 5 anesthesiologists experiencing an adverse intraoperative episode continued to carry the stress and guilt associated with that catastrophe for an extended period

of time. When additional stressors are added to their already existing stress, without adequate coping mechanisms, substance abuse might be viewed as self-medication for dealing with the emotional upheaval. Recognition of this profound problem by the Association of Anaesthetists of Great Britain and Ireland lead to an important monograph being developed concerning how major catastrophes in anesthesia practice should be dealt with after they have occurred[151]. Recommendations concerning how best to deal with a major adverse intraoperative event are detailed taking into consideration the major impact that such an event has on an anesthesiologist's emotional state.

Figure 6 – The time it took to achieve emotional recovery after having experienced an intraoperative catastrophe.



(Figure taken from: Gazoni FM, Amato PE, Malik ZM Durieux ME; The Impact of Perioperative Catastrophes on Anesthesiologists: Results of a National Survey; *Anesth Anal;* 2012; 114:596-603)

It is evident from the Gazoni study[149] that 5% of the anesthesiologists turned to substance abuse as a way to cope with a medical disaster. Based upon these dramatic findings some recommendations were suggested to help the anesthesiologist cope following an intra-operative disaster[152]. First a serious evaluation must be performed by anesthesiology groups and health care organizations concerning how to handle a practitioner's operative schedule immediately after that practitioner experiences an intra-operative catastrophe. Due the emotional upheaval and distraction produced by such an event, having the anesthesiologist take a break from continuing to provide care for other patients might help prevent a "third victim" arising from these unfortunate circumstances. The "third" victim being the next patient the cared for by the distracted and stressed anesthesiologist. Secondly, anesthesia groups and health care organizations need to be proactive in setting up an acute support system for the anesthesiologist that has an intra-operative disaster and provide mental health referral to prevent that practitioner from turning to dysfunctional mechanisms in order to cope with the accompanying emotional upheaval. Thirdly, as part of an ongoing

wellness program, the anesthesia department and health care organization need to have in place on-going monitoring of each practitioner's mental state, since psychological impairment and substance abuse are two significant long lasting results of an adverse event. Part of this long term monitoring program should be the offering of educational programs directed at methods for coping with the stress of an adverse intra-operative event. Finally, a formal evaluation of the efficacy and impact on the practitioner of critical incident reviews and full disclosure recommendations should be carried out. At present there is anecdotal evidence that such activities may be helpful but scientific substantiation is presently lacking[152].

Because of the extraordinary long term impact of a medical error or intra-operative catastrophe on the typical anesthesiologist, it might be expected that there could be hesitation in reporting such an event. One study found that there were attitudinal and emotional barriers to reporting an adverse event, if the event was caused by the practitioner[153]. When presented with a scenario of a patient having an anaphylactic reaction due to an error by the anesthesiologist, as opposed to the same scenario when no error was made, a greater number of anesthesiologist thought that there would be greater barriers in reporting the error of induced anaphylaxis than one that occurred without culpability.

The keys barriers to reporting were "litigation, getting into trouble, disciplinary action, being blamed, unsupportive colleagues and not wanting the case discussed in meetings"[153]. The increased reticence for reporting an intra-operative catastrophe, especially when an error is made, can cause the solitary and isolated anesthesiologist to become even more introverted and guilt ridden. Without coping mechanisms in place a dysfunctional response may be the result. In spite of calls for anesthesiologists to engage in full disclosure and to be part of the team that provides direct medical error disclosure to the patient and family, such a system is rarely in place[154]. In fact evidence would indicate that even when an incompetent physician is recognized in a practice, other physicians are reluctant to report their concerns to the authorities[155].

Because every anesthesiologist will at one time in their career have to face a patient or the patient's family and admit that an error in judgment or skill occurred, it would seem that active training for dealing with this situation should be incorporated into every residency training program. In addition in order to prevent substance abuse or suicide as a way to cope with overwhelming guilt and anxiety, part of every training program should include education on how to deal with medical errors. Each institution should have a support system in place to help the practitioner past these difficult times.

Malpractice Litigation

One unfortunate and emotionally draining outcome for a physician involved with a medical error leading to patient harm is a malpractice lawsuit[156]. Not only are physicians involved in a medical error often overcome with guilt from having a patient under their care experience an adverse outcome, but the stresses of dealing

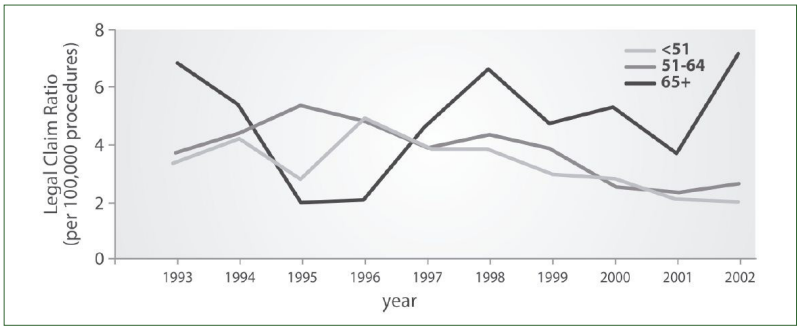
with a malpractice lawsuit can become overwhelming. A typical response seen in over 95% of physicians receiving notification of a pending malpractice lawsuit is severe emotional distress that intensifies as the malpractice suit progresses[157]. In fact the initial sense of anger, shock and dread is equivalent to any major severe negative life event, such as the loss of a spouse or loss of a job[158].

The stress is amplified by secondary psychological responses, such as insomnia, depression, feelings of self-doubt, ideation of inadequacy, intensification of physical symptoms from existing illnesses, the development of new illnesses, and turning to alcohol or other substances for tension reduction. Without a psychologically supportive coping system in place which utilizes family, friends, and the physician's anesthesia department colleagues, it is understandable how the stresses of malpractice litigation might well end in addiction and/or suicide[159].

Unfortunately, anesthesiologists seem to be particularly at risk for these adverse psychological outcomes, most likely due to their personality makeup. In fact anesthesiologists involved in medical malpractice litigation have been singled out as being at higher risk for suicide than other medical specialties, with some 2.2% in one study having committed or having attempted to commit suicide[160]. Of interest when compared to other physicians, anesthesiologists are not sued on a more frequent basis[161]. In fact the findings would indicate that on an annual basis across specialties, while 7.4% of all physicians had a malpractice suit and 1.6% had to make an indemnity payment due to the suit, anesthesiologists actually had fewer suits and less frequent payments. In addition anesthesiologists also fell below most other specialties in the median amount paid out in malpractice awards with the median payment for anesthesiologist being slightly less than $100,000 and the mean payment being slightly less than $300,000[161]. Therefore, the higher risk of suicide and substance abuse cannot be attributed to a higher rate of lawsuits or higher awards.

One special subgroup of anesthesiologists at risk for malpractice litigation is the elderly anesthesiologist. In a survey of anesthesiologists of various ages anesthesiologist over 60 years of age generally had shorter work weeks than their younger counterparts, although 5% of them continued to work 70 to 79 hour weeks. There was no statistically significant difference in hours worked among men and women. In addition the older anesthesiologists seemed to provide care to less complex cases[101]. Therefore, with fewer and less complex cases, one might expect that litigation would decrease for the older anesthesiologist. The findings are the opposite, as shown by a study from Canada[100], where a correlation existed between anesthesiologist over the age of 65 years of age and the occurrence of law suits. Both the risk of a malpractice lawsuit and the higher severity of injury to the patient were the findings for care provided by an older anesthesiologist. In spite of these findings, most malpractice suits against anesthesiologists are groundless[162,163].

Figure 7 – The legal lawsuit ratio evaluated each year from 1993 to 2002 for anesthesiologists in three age ranges. The anesthesiologists over 65 years of age had a higher claims ratio then their younger counterparts.



(Figure taken from: Tessler MJ, Shrier I, Steele RJ; Association between Anesthesiologist Age and Litigation; *Anesthesiology*; 2012; 116:574-9)

For older anesthesiologists (see **Figure 7**) the increased number of legal claims may point to more errors being made. Trying to dissect out the root causes for this increased litigation is not straight forward. Fatigue from old age and cognitive dysfunction might be root causes but until this is further determined, a rush to "retire" older anesthesiologists is premature[164]. However, it must be recognized that the older anesthesiologists are also at risk of suicide and substance abuse when facing malpractice litigation; and like their younger counterparts, they need support systems in place to help them cope with the more frequently encountered stresses of a malpractice suit.

Availability factors and ease in diverting

When evaluating the drugs of choice for anesthesiologists becoming addicted, (see Table 1), it is evident that drugs readily obtainable in common anesthesia practice are selected far more frequently than illegal street drugs. In addition as drug usages change with changing anesthesia practices, the new drugs that are introduced also become the incorporated into the list of abused drugs. A case in point is propofol which has increasingly become a drug abused by anesthesia personnel[165-167]. For a long time it has been suspected that a key factor related to the abuse of drugs by anesthesiologists is their easy accessibility in the normal daily practice of anesthesia[168,169]. Therefore, it would not be unexpected that the drugs found being the cause for addiction were ones commonly found used by anesthesiologist in their daily practices. In some anesthesia residency programs decades ago personal use of anesthetic agent was encouraged as a way to better understand "what the patient experienced". Obviously, with present knowledge of the severe addictive effects of even one usage of modern anesthetic agents, such practices are unacceptable.

There are essentially two methods for helping to ensure drug availability does not become a factor in the addiction of anesthesia personnel: **1)** rigid control of drug dis-

pensing and return or; **2)** random drug testing of all anesthesia personnel. Neither are foolproof but each may have certain advantages. In regard to control over drug dispensing and return, there are now automated systems[170], such as Pyxis Med-station, that dispense a drug only after a practitioner has entered an individualize password into the system. It also requires a second practitioner to enter their individual password to substantiate the witnessing of unused drug disposal at the end of a case. A review of a practitioners drug usage compared against the anesthesia records will turn up any discrepancies that would need to be investigated and explained[171] An alternative method is each time an addictive substance is used it must be signed out by a specific responsible practitioner and all unused rug returned to the pharmacy for periodic random drug testing. Once again comparisons between the anesthesia record documented drug use and the amount of drug dispensed would indicate discrepancies that could point to anesthesia personnel at risk for substance abuse[172-176]. However, with any system of this nature, the driven addict can effectively hid drug diversion. One of the most insidious ways of diverting drugs for personal use is by substituting a non-anesthetic solution, such as saline, for the drug being diverted. The patient therefore does not receive the documented drug and must suffer the consequences, which might include awareness under anesthesia, or post-operative pain[177]. Less traumatic for the patient is simply indicating more drug is being used for a particular patient than actually given but these relatively larger drug usage patterns can be picked up over time with the audits[178].

The other approach proposed for decreasing substance abuse among anesthesia personnel is random drug testing. In spite of many industries now routinely using random drug testing for employees whom might harm the public if under the influence of drugs, a similar idea of random drug testing of high risk medical personnel has not been embraced[179]. Due to significant concerns about substance abuse in younger anesthesiologist, particularly residents in training, some institutions have begun instituting random urine testing for drugs, as an early warning signal and as a deterrent[180,181]. The effectiveness of random drug testing as a deterrent has been proven for individuals under surveillance for past drug abuse - mainly because of the severe adverse consequences of having a positive urine test[182,183]. Similarly, the institution of random drug testing in residency programs at the Massachusetts General Hospital[180] and the Cleveland Clinic[181] were based upon a belief that residents educated about the career destroying effect of a positive test, would actively avoid any form of substance abuse. The results of the Massachusetts General Hospital experience were a change in the rate of substance abuse before the study from 1-2% to a 0% positive rate. In spite of the existence of methodological issues in this study, the conclusion was that the $50,000 cost of a fully implemented program was minimal compared to the cost of the lost life or productive professional years of a single resident deterred from sampling drugs and becoming addicted. This evaluation is particularly relevant paced in context of the increased concern that once addicted, especially to narcotics, an anesthesiologist should be redirected away from the practice of anesthesiology[184].

No matter what the eventual mechanism found to have greatest success in deterring anesthesia personnel from abusing the drugs they use to provide patient care, there is no question that at least for some practitioners that have become addicted, one factor in their addiction was their easy access to drugs and the lack of accountability that the drugs were being used for their intended purpose.

Personal Psychological Factors

Though genetics and many other factors play important roles in the development of substance abuse, as well as suicidal tendencies in any individual anesthesia provider, pre-existing personality traits also play a significant role. Though the relative contributions of genetics as opposed to environmental and demographic factors in the development of drug addiction have been explored previously, the same arguments can be made between the importance of genetics or environment on the development of personality traits. In the final analysis, they both play significant roles. When individuals with substance abuse are evaluated, over 50% are found to have personality disorders[185]. The fact that people with personality disorders have such a high incidence of drug abuse has led some to hypothesize that the drug abuse is simply a form of self-medication – reinforced by improvements in the internal psychopathological state[186]. Depression is frequently found as a co-morbidity of physicians at risk for drug abuse and suicide but the difficulty in evaluating this is dissecting out whether the depression caused the addiction or was the result of the addiction[187], 188. However, as in genetic family studies of addition, depression is significantly higher when there is a family history of depression[189,190]. In addition physicians in general tend to have behaviors making them more vulnerable to depression[159]. (see **Table 5**) The lack of sleep leading to fatigue has already been explored in regard to overall health, but poor nutrition, due to grabbing meals whenever possible, lack of time for routine exercise, use of caffeine on a frequent basis, as well as social isolation due to a desire to be left alone to recuperate when off duty, all conspire to produce burnout and the use of substances as a form of self-medication.

Table 5 – Behaviors listed increase the likelihood of a physician turning to drugs to relieve stress and burnout. Most of these behaviors are a direct result of physician's desire to put the patient before themselves.

Counter productive physician behaviors
Lack of sleep
Lack of nutritious food
Lack of physical exercise
Lack of friendly positive social interactions
Dependence on stimulators such as caffeine
Ignoring own health concerns for an extended period

Additionally, personal psychological traits may also influence a physician to turn to substance abuse. Physicians often hide behind a syndrome of perfectionism or "Godliness,"

which does not allow the possibility of making an error. When errors inevitably are made the mask of perfectionism is destroyed and the physician has the unpleasant task of facing the reality of his/her vulnerability, which for some is intolerable[191]. In addition one addicted professional offered insight into his addiction as being caused by his own long standing self-delusion and intellectualization that his drug use was both controllable and without professionally consequences[192]. It was only after his career, reputation, and personal life had been ruined that he realized that the control he thought he was exerting was imaginary. For anesthesiologist as a profession, individuals develop the syndrome of perfectionism and adopt a "belt and suspender" approach to patient care. It is this conscientiousness that has in part led to the major improvements in mortality for patients undergoing anesthesia care over the past three decades. However, such an attitude also leads to an unrelenting need to never relax one's vigilance which in turn over long hours in the operating room leads to fatigue and burnout.

Anesthesiologists also want to have complete control but in an operating room environment where one is part of an integrated team, control is divided. Battles over where the ambient temperature should be set, the level of noise in the room, when blood should be given and the myriad of other issues that arise daily, tend to erode the buffers allowing for smooth interpersonal interactions. The more stress, the greater the tendency to burnout. Independence and isolationism is also part of the psychological make-up of many anesthesiologists. The ability to take independent action and have autonomy may well have been one reason medical students are attracted to the profession of anesthesiology. However, this same independence and isolationism makes it hard for the anesthesiologist in need to reach out and ask for help. If internal coping mechanisms are not in place or if the anesthesia practice does not have active support mechanisms for staff, the troubled anesthesiologist may turn to mal-adaptive ways in an attempt to cope with the stress.

Chronic Sub-Therapeutic Exposure To Second-Hand Drugs

Though highly controversial one other factor that may increase the chances of an anesthesiologist becoming addicted to the drugs used to provide anesthesia care is that chronic exposure to expired sub-therapeutic levels of the anesthetic drugs by a patient may sensitize brain addictive pathways which then predisposes to drug seeking behavior[193]. Examples of drug exposure causing changes in neuronal pathways are well established[194-196]. Many addictive substances are abused due to their effects on either decreasing stress or augmenting the neuronal reward systems. These effects are modulated by inducing a change the normal levels of the neurotransmitters, such as gamma-aminobutyric acid, dopamine, and serotonin. However, more insidious is the possibility that very low level exposure to drugs might also induce similar changes and a predisposition for abuse of drugs.

By producing changes in the neurotransmitter level, a lack of exposure for a period could manifest as withdrawal symptoms[197,198]. Specifically, propofol and fentanyl exhaled by the patient in molecular amounts and inhaled by the anesthesiologist are

considered a possible predisposing cause for addiction. In addition exposure to inhalational agents exhaled by the patient might activate otherwise dormant addictive neuronal pathways. There is a whole area of addiction medicine, called epigenetics, that is exploring the concept that exposure to drugs may actively affect the genetic expression of alleles which in turn increases the predisposition to addiction.

Epigenetics was originally discussed in 1942[199], as a way various drugs might alter genomic expression without actually changing the DNA sequence. It is thought that the drugs act on genomic expression by two mechanisms – methylation of existing DNA which alters the DNA function and modification of the proteins surrounding the DNA which in turn alters genomic expression[200,201]. If abused substances can change brain chemistry via genomic expression so that a lack of the drugs produces a withdrawal symptomatology, one can understand the origins of addiction. When this occurs with second hand exposure to sub therapeutic levels of anesthetic agents that most anesthesiologists come into contact with on a daily basis, one can understand the concerns that are raised in regard to the health and safety of the anesthesia workforce.

Drug seeking behavior in the face of withdrawal symptoms is simply an attempt to re-establish "normal" brain chemistry which has been altered from previous drug exposure. For the anesthesiologist who has unwittingly been exposed repeated to the second hand drugs and just does not "feel right" from withdrawal symptoms that cannot be otherwise identified, one can understand that even a single exposure to the substances that re-establish "normalcy" could trigger addictive behavior. At present the occurrence of addictive predisposition from sub therapeutic second hand exposure to anesthetic agents remains hypothetical but plausible.

Summary

Substance abuse, addiction, burnout, and suicide are occupational hazards of anesthesia practitioners. Though these problems have been recognized for decades, few countries have taken constructive action to intervene and prevent the resulting devastating loss of life, loss of professional work hours, and personal emotional trauma. The cause for the deadly downward spiral is multifactorial. Genetics is increasingly being recognized as a critical factor in the development of addiction. Findings from both family and population studies suggest that the contribution of genetics might be as high as 50% for the predisposition toward the development of substance dependency. Genetics also have an important role in protecting against addiction due to varying genetically controlled actions on either the metabolism of abuse substances or by alteration in the manner the substances interact with neuronal receptors. However, having a genetic predisposition does not sentence a person to becoming an addict. Many demographic, environmental and individual factors can modify both the predilection, as well as the protective effects of genetics. Research into these complex interaction of genetics on substance abuse in actively progressing and should be better defined in coming years.

Aside from gene variations, causes specific to anesthesia personnel that can lead to substance abuse include the many unique stressors encountered in the modern operating room. Also causative of stress is the expectation of perfection that is a central part of anesthesia medical training. The long hours of work with the attendant emotional physical and mental fatigue serve to reduce an anesthesiologist's stamina and coping ability.

Fatigue is a strong independent factor that increases the likelihood of a medical error being made, which adds high stress and increases the fatigue factor even more. Also, catastrophic occurrences in the operating room, whether due to medical error or not, have devastating and long term effects on the anesthesia practitioner. If a malpractice suit occurs, anesthesiologists seem to be disproportionally affected with resultant higher drug seeking behavior and suicide. Part of these responses may in part be ascribed to personality traits often found in anesthesiologists such as perfectionism, isolationism, and independence. Part of these responses may also be due to the lack of institutional and departmental support systems, so that drugs are viewed as the only outlet for overwhelming stress.

Finally, one as yet unproven cause for substance abuse among anesthesia providers, other than easily availability of the drugs, is second hand exposure to exhaled drugs from the patient. Fentanyl, propofol and all the inhalational agents are exhaled by patients in small amounts, as they recover from the effects of anesthesia. Though the concentrations of the drugs are sub therapeutic, it has been proposed that these second hand drugs secondarily inhaled by the anesthesia practitioner may induce neuronal pathways that can predispose to addictive behaviors and perhaps even withdrawal symptomatology. Though plausible, this explanation for substance abuse by anesthesia personnel is as yet unfounded.

The problem of fatigue, substance abuse and suicide among anesthesia personnel is finally getting attention world-wide. The World Federation of Societies of Anesthesiologists is taking an active role in pointing out that this problem is not isolated to specific nations but rather is world-wide. Only through honest recognition of the problem can steps be developed to intervene and prevent its occurrence.

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Burnout Syndrome In Anaesthesiologists - The Actual Reality

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Anesthesiologists' Well-Being

The intricate relationship between work life balances can either manifest itself positively in an individual, resulting in positive job engagement and pleasure filled life. Or at the other end of the spectrum, this can negatively impact the person's social and psychological being resulting in stress and burnout. With present interest in "Weingology", that is, the science of studying well-being, we hope to understand more this intricate relationship between work and life.

In this chapter, we would like to review the personal well-being of anesthesiologists, focusing on burn-out syndrome. Anesthesiologists are expected to render patients "stress-free" as they undergo any diagnostic or therapeutic procedure. *Ironically*, as the anesthesiologist carries out his daily work, he is placed under undue stress because of the inherent risks in every anesthetic and surgical procedure, aggravated by production pressure and /or lack of resources at work environment.

The increased application of economic and business administration principles to health care in the late 20th and early 21st centuries inevitably led to the introduction of management practices to improve the efficiency of anesthetists[1]. The pressure of a growing economic competitiveness and the need to do more with a reduced workforce are associated with the emergence of more difficult cases. This transformation has impacted the occupational well-being of anesthesiologists[2].

Anesthesiology is a medical specialty that has been singled out as having made major advances in patient care safety over the past few decades. Both morbidity and mortality rates have undergone significant improvements due to innovations in pharmacology, monitoring and clinical approaches. Yet patient harm secondary to errors made by anesthesia practitioners continues to exist in spite of the many other advances. One key cause for practitioner error that is well documented in the medical literature is the practitioner's level of fatigue[3].

Through this chapter, we aim to create awareness about Burnout Syndrome among the medical fraternity and especially discuss its prevalence among anaesthesiologists in different parts of the world, as we know it today. Available literature has been reviewed and the magnanimity of this problem, its causative factors, its effects on the work and life of anaesthesiologists globally and their various coping mechanisms have been discussed. Most of the available research has focussed on the negative aspects of stress and burnout at work.

In this chapter, we would like to strike a balance and encourage a shift of focus for future anaesthesia research on the positive traits of job involvement/engagement and pleasures at work. We have tried to raise various concerns in the work of an anaesthesiologist, and how best it can be dealt with.

In Nicomachean Ethics, written in 350 BC, Aristotle states his famous **Eudaimonic Theory of Happiness**[4]. He says that happiness (also being well and doing well) is the only thing that humans desire for its own sake, unlike riches, honor, health or friendship. He observed that men sought riches, or honor, or health not only for their own sake but also in order to be happy. He believed that virtue brings attainment (fulfillment), and fulfillment brings happiness.

Aristotle also believed in the importance of certain goods and fortune in shaping well-being. In addition to virtue (moral and intellectual excellence) and physiological well-being (e.g., health), which he considered "internal goods" (i.e., they exist *in* the self), the successful pursuit of happiness also required "external goods" as friends, wealth, political power, and security – i.e., what Aristotle calls "external prosperity." External prosperity and physiological well-being depend to some extent on good fortune, which means that one's happiness can be undermined, at least to some extent, by ill fortune[5]. With this historical background, can we find some parallelism by which anesthesiologists can find personal well-being while at work?

A new term "Weingology" has been proposed with an aim to promote well-being at work. We hope that scientific research and future clinical studies will help create awareness and interest in this topic, helping it to develop into an independent speciality, or be an important part of every medical curriculum.

What is Burnout Syndrome

Burnout is a psychological term that refers to long-term exhaustion and diminished interest in work. It is work specific, occurs in individuals who did not have any preexisting psychopathology and commonly found in care giving professions. The term *burnout* in psychology was coined by Herbert Freudenberger in his 1974 article *"Staff burnout"*, presumably based on the 1960 novel *"A Burnt-Out Case"* by Graham Greene, which describes a protagonist suffering from burnout quits his job and withdraws into the African jungle[6].

Several definitions and theories abound to describe Burnout and its associated symptoms that are collectively called "The Burnout Syndrome". It has been hard to describe Burnout Syndrome, since it is more of a subjective feeling and rather difficult to objectify. Simply put, Burnout Syndrome is a state of being, in which the individual is unable to cope up with the demands of his work environment, feels de-energised and loses interest in his work outcome. How close one can get to burnout depends on the individual's capacity to handle stress.

The most widely accepted work for quantitative assessment of Burnout is the Maslach Burnout Inventory (MBI) developed by Maslach and Jackson in 1981[7]. They have defined burnout syndrome as having three dimensions of emotional exhaustion, depersonalisation and a feeling of lack of personal accomplishment[8]. Emotional Exhaustion (EE) is the central component of the syndrome, and for most practical purposes, the term Burnout is synonymous with the experience of exhaustion.

Depersonalization (DP) is an attempt to put distance between oneself and service recipients by actively ignoring the qualities that make them unique and engaging people. It is characterised by a negative and unaffected attitude towards their patients. Feeling of lack of Personal Accomplishment (PA) arises when one's efficiency is compromised by lack of adequate resources to cope. A high level of burnout is defined by a high level of EE, high level of DP and low level of PA.

In the 10th revision of the International Classification of Diseases (ICD 10) the term 'burnout' has been described under Z.73.0 as 'Burnout-state of vital exhaustion' [9]. Occurrence of burnout syndrome in diverse occupations, e.g. in social workers, advisors, teachers, nurses, laboratory workers, speech therapists, doctors and dentists, police and prison officers, stewardesses, managers, and even in housewives, students and unemployed people has also been described[10]. In most of these occupations the combination of caring, advising, healing or protecting, coupled with the demands of showing that one cares is of central importance.

Occupational psychosocial and psychomental stress factors for burnout etio-pathogenesis have been discussed, namely pressure of time, overtime and shiftwork, lack of autonomy as well as mobbing, economic pressures, and multiple tasks such as job, family and leisure activities. In addition, the importance of personal competence, particularly in the so-called tertiary sector, is continually increasing (e.g. communicability, being able to work in a team, frustration tolerance, service orientation, flexibility).

The climate in medicine is also changing: production pressure lead to less doctor-patient contact time, an increase in paperwork, a trend towards managed care, reduced government spending, diminished physician resources and increased medical school tuition[11]. At the same time, patients have become more strenuous and demanding, have higher expectations, and no longer have the same respect as they used to have for doctors. All these factors not only contribute to lower job satisfaction but can also cause a decline in autonomy and control in doctors.

Undeniably, high job satisfaction can be a potential buffer against the development of burnout. When doctors' 'investment' in their work– which may include time, effort, empathy, or attention – are reciprocated by patients showing gratitude and appreciation after a consultation, or when patients recover after treatment, the investments and outcomes are balanced, and equity exists. Lack of reciprocation contributes to imbalance.

According to the **job-strain model**[10], which has been established for many years in occupational medicine as a stress - strain concept, a high level of strain can result

from the accumulation of psycho-mental/psycho-social stress and a lower level of stress tolerance, which in this context is to be regarded as "negative stress". When "negative stress" becomes chronic and is not dealt with adequately it leads to adverse effects on the health. Not only do psychological and social factors play a role, but so also do biological and biochemical factors. Above all, hormonal and endocrinological changes, particularly a permanent increase in the cortisol level and disturbances in the hypothalamic - pituitary -adrenal control system are also being evaluated.

Risks of Burnout among Doctors

The risk of burnout is influenced not only by the extent of the stress factors and deficits in personal resources, but above all by "social support" systems and "coping" strategies. Primary personality structure that leads to burnout includes: idealism, perfectionism, timidity, insecurity, emotional instability, inability to relax.

Negative factors which influence the individual stress tolerance are: inadequate or lacking strategies to deal with stress, disappointed expectations/ negative experiences, inadequate support due to a lack of social relationships/partnerships, lack of patient gratitude for medical care provided, risks of litigation.

A study by Reeve et al[12] distinguishes two types of anesthesia trainees as judged successful and unsuccessful on the basis of the assessments by seniors and have compared their personal profile. The successful trainees demonstrate greater detachment, mental quickness, drive and determination, stability, high standards, self-sufficiency, openness and self-control. These personal resources may buffer against stress perception.

Social support[11] is believed to be a buffer against stressful work life. However, when there is little time left to spend with your family, the opportunity for help from your spouse or partner is limited. Time away from work has been identified as a contributor to burnout reduction, as it has been shown that part time general practitioners have significantly less signs of burnout compared to their full-time counterparts[13].

In addition, gender differences in this context are worth further comment. Female physicians may be involved with home and family organisation to a greater extent than their male counterparts. Hence, they may have better social support but also higher workload and less time for themselves. Gender however, has not been shown to be a strong predictor of burnout[14]. Maslach[8] surveyed 2,247 male and 3,421 female participants during the implementation of the Maslach Burnout Inventory (MBI) model and concluded that no significant difference was found.

Doctors are the least likely to admit that they are under stress themselves[11]. Self-care is not part of the doctor's professional training and is typically low on their list of priorities. In fact, many doctors don't even have their own general practitioner. Early recognition of their problems prevents further deterioration of their mental and physical health and more specifically the development of burnout.

Manifestations of Burnout Syndrome

Symptoms[10] of burnout include concentration and memory disturbances (a lack of precision, disorganization), a lack of drive and personality changes (a lack of interest, cynicism, aggressiveness). Severe disturbances are anxiety and depression, which can culminate in suicide. Also the development of addictions (e.g. alcohol, medicines) has been associated with burnout[15,16].

A tendency towards substance abuse – alcohol, drugs and pharmaceuticals, may develop as almost 10% of health professionals develop a substance related disorder at some point in their lives. The access to pharmaceuticals, thrill seeking, and self-treatment of pain increase the risk for addiction[17,18].

Depressive feelings are often the consequence of burnout symptoms with suicide sometimes as the final disastrous outcome[19]. Their access to drugs, in combination with these depressive feelings, could explain why this tragedy is more prevalent among people working in medicine than most other professions. Common somatic symptoms[10] are headaches, gastro-intestinal disorders (irritable stomach, diarrhoea), or cardio-vascular disturbances such as tachycardia, arrhythmia, and hypertonia.

Social consequences manifest as withdrawal at the workplace, partner/ sexual problems and social isolation. From the perspective of society, there is an increased risk of repeated or long periods of absence from work and early invalidity. All this puts not only the individual at risk, but also compromises on patient safety.

Particularly depersonalisation and reduced personal accomplishment can have devastating effects. The more cynical attitude can result in a decrease in empathetic concern towards their patients, a psychological withdrawal from work, irritability and lack of patience[11].

The reduced feeling of competence that is associated with burnout can result in a decreased subjective and objective performance evaluation in doctors as well as nurses. Patients show lower adherence to physician's advice from doctors with low job satisfaction, who are unhappy, cynical and irritable.

Moreover, physicians with low job satisfaction have been linked to inappropriate medicine prescribing patterns and to a boundary violation or unethical physician conduct, such as sex with patients, violation of patient confidentiality, or prescribing for self[11].

Differential Diagnosis

It may be first required to separate primary psychiatric disorders, i.e. those independent of exogenous factors, from burnout. Furthermore, chronic somatic diseases, such as chronic infections (e.g. viral hepatitis), endocrinopathy (e.g. thyroid disorders, Addison's disease), auto-immunopathy, tumours or the so called **chronic fatigue syndrome (CFS)** must also be considered.

Differentiation between burnout and CFS can, however, be rendered impossible by similar symptoms and a comparable course of the disease[10]. However, we feel that burnout is work specific (different from psychiatric disorders which may be pre-existing, or show no relation with change of job). Burnout syndrome is also not immediately reversible on withdrawal of job stressors, and may require more emotional/social and rehabilitative measures to bring back normalcy (as opposed to CFS which may revert with adequate rest and cessation of stressful activities). Again, Burnout appears to be more of a qualitative phenomenon, as opposed to CFS which may be more of quantitative in its nature.

Prevalence

Many studies report high levels of burnout in doctors, with psychological morbidity ranging from 19% to 47%, compared with a rate around 18% for the general employed population[11]. For primary care doctors or general practitioners, most studies report a moderate degree of burnout, especially for the emotional exhaustion dimension. Studies in several Western European countries, including Switzerland, Italy and France, report prevalence ranging from around 20% to more than 50%. Anaesthesiologists also have moderate degrees of burnout, with high job satisfaction moderating the negative effects of stressors at work. However, the literature is not consistent in what medical speciality the highest percentage of burnout can be found.

Prevention

According to the WHO the levels of prevention can be divided into primary preventive measures (avoidance/removal of factors that make the patient ill), secondary measures (early recognition—intervention of manifest disease), and tertiary measures (coping with the consequences of disease—rehabilitation and relapse prophylaxis). The concepts for behavioural preventive measures presented in the literature focus on primary prevention and are the "domain" of psychology[10,11]:

Measures aimed at improvements in stress management include[10,11,20-23]:

- Counselling and learning of relaxation techniques
- the delegation of responsibility (learning to say 'no')
- hobbies (sport, culture, nature)
- self care (exercise, nutrition, meditation)
- trying to uphold stable partnerships/social relationships, spending time with family and friends
- frustration prophylaxis (reducing false expectations)
- religion and spirituality is regarded by some as having a potentially preventive function

Workplace related measures are:

- creation / preservation of a "healthy working environment"
- time management
- communication style of leadership
- reviving values, motivation and goals
- learning orientation- motivation of individuals to learn and increase their competence
- recognition of performance- praise, appreciation, reward programs, money
- training of managers ("key role" of the boss in burnout prevention)

Person-oriented strategies are:

- Carrying out of "suitability tests" before job training
- Peer Support groups, conducting specific programmes accompanying the work of persons from risk groups (e.g. Balint groups for teachers and doctors)
- Regular occupational – medical/psychological monitoring (e.g. establishment of a special "job-stress" checkup for the early recognition of burnout)

Engagement[24] represents a desired goal for any burnout intervention. It promotes a system which is likely to enhance employees' energy, vigor and resilience; promotes their involvement and absorption with the work tasks; and ensures their dedication and success on the job.

A structured process, CREW (Civility, Respect, and Engagement at Work)[25], has been demonstrated to improve civility among coworkers, ultimately transforming into improvements in the cynicism dimension of burnout, job satisfaction, organizational commitment, and management trust. Regular organizational assessment of well-being in employees provides evidence on the overall health and well-being of the organization, as well as indicators of areas of strength and areas of possible problems that need to be addressed.

Burnout is more than just exhaustion. There are five more possible domains of job stressors than workload itself that may affect development of burnout. In such conditions, an organizational checkup process is one effective way of showing these organizations what the other possibilities are in their case.

Maslach et al[8] have proposed six areas of "individual-job" fit model which include: a sustainable workload, feelings of choice and control, appropriate recognition and reward, a supportive work community, fairness and justice, and meaningful work. This model focuses on the degree of match, or mismatch, between the person and six domains of his or her job environment. The greater the gap, or mismatch, between the person and the job, the greater the likelihood of burnout; conversely, the greater the match (or fit), the greater the likelihood of engagement with work.

Although one is tempted to believe that workload may be the primary factor for burnout, it may not be true in all cases – other areas, such as fairness, or control, or workplace community, may turn out to be the more critical points! Research trials and projects aimed at evaluation of the interactions of these six areas may contribute richly towards the future development and expansion of Weingology.

Burnout Studies among Anesthesiologists

In **Romania,** a survey[26] on prevalence of Burnout Syndrome was carried out on Anesthesia Intensive Care (AIC) physicians. Their average working week was 70 hours. High levels of burnout by using MBI scale was found in 29.85% of respondents, while moderate levels in 53.03% and low levels in 17.12%. A high level of emotional exhaustion (EE) was found in 34.2%, depersonalization (DP) 38.4% and a low level of personal accomplishment (PA) in 37.7% of the doctors from the survey. They found a statistically significant (p 0.027) higher prevalence of EE in female anaesthetists (mean 23.82) compared with male doctors (mean 19.53).

Workload, AIC specific work and daily hassles were found to be predictive factors for development of EE. In addition, managerial role among AIC personnel was found to be a strong predictor for DP. The burden of the difficult work meant working with critically ill patients (trauma patient; septic patient; exposure to contamination; burned and brain dead); working under pressure; being active and alert all the time; expecting high quality results in lives saving, keeping up with the new technology and the modern treatments; needing time for continuing medical education; and being always approachable to patients, relatives, colleagues.

The attending physicians had longer working hours per week than the residents but the level of exhaustion was not significantly different. Despite the fact that the Romanian AIC physicians worked more hours per week than other specialties, they did not identify a relationship between this independent variable and burnout.

Exhaustion is a result of physical, mental and emotional fatigue. They list several causes of exhaustion: job demands (severity of patient problems), poor communication with people on different levels of the professional scale (head physicians, subordinates, colleagues, and patients), unfair or unsatisfactory rewards, too much responsibility and too little support, or the need to quickly acquire new skills and knowledge.

All these findings reinforced the need for: a higher number of Romanian AIC physicians to decrease the number of working hours, continuous medical education, good AIC resources, and stress management education. A limitation of the study was that only 15% of the Romanian AIC doctors were surveyed, therefore the results may not be representative for the whole population of Romanian AIC doctors.

A study of **French** medical intensivists found a much higher incidence of burnout[27] as compared to the above mentioned study of Romanian anesthetic intensivists. Using the MBI, a high level of burnout was identified in 46.5% of the respondents, 23.3%

reported a low level of burnout and 30.2% indicated a moderate level of burnout. About 50% of the intensivists exhibiting a high level of burnout wished to leave their jobs. However, for people who stayed on the job, burnout lead to lower productivity and effectiveness at work. Consequently, it was associated with decreased professional satisfaction and reduced commitment to the job or the organization. Conflicts with coworkers (with another intensivist or nurse) were associated with the higher level of burnout. In contrast, good quality of the relationships with nurses and chief nurses was associated with a lower degree of burnout.

Prevalence of stress and burnout in anesthetists in **Belgium** University Network has been studied by Nyssen et al[28]. By using the Psychological State of Stress Measure (PSSM-A) scale[29], they revealed a moderate level of stress in anaesthetists that was no higher than in other professional groups (median stress level in anesthetists was 50.6, policemen 50.6, office workers 51.3; levels greater than 60.0 represent severe stress). Almost 17.9% of the anaesthetists were in the high stress-level group and 72.8% and 9.3%, respectively, in the medium- and low-level groups. The third-year anesthetists in-training showed the highest stress scores (this year of training is particularly critical because this is when the trainees start to work on their own in the operating room, calling for help when problems occur).

The most frequently reported health problems (Physical Health Scale[30] to identify some negative health consequences) were headache (15%), stomach ache (12.5%), intestinal ache (7%) and ulcers (6%). The median score for burnout (MBI-Emotional Exhaustion subscale) was 27 (range 10±59), which corresponds to a moderate level according to the normative scores. 40.4% of the anaesthetists were in the high-level burnout group and 44.4% and 15.2%, respectively, in the medium- and low-level groups.

Surprisingly, anaesthetists under 30 years of age showed the highest burnout rates. The lack of empowerment and the lack of support/quality supervision, by decreasing the individual's ability to cope with stressful situations, could explain the high score for emotional exhaustion found in the young anaesthetist group. Through the Working Conditions and Control Questionnaire (WOCCQ)[31] they found that the anaesthetists felt a lack of control mainly over time management (overtime, difficulty taking a break and planning non-clinical tasks such as lectures, scientific research, etc.), work planning (difficulty in getting the work schedule in advance, frequent changes during the day), and risks.

There was a negative correlation between stress and control scores. Men indicated a higher level of empowerment and control over risks. The most frequent problematic situations (the Problematic Job Situations Questionnaire, developed by the same authors to supplement WOCCQ) cited were a) related to `work organization: 35% (e.g. unpredictability of schedules, lack of coordination within the team, length of workdays, inappropriate supervision); b) inherently difficult job situations: 25% (e.g. difficult intubation or recovery); c) interpersonal relationship conflicts: 17% (e.g. lack of communication within the team, with the surgeon etc.); d) doubt and

pressure on responsibility: 16% (e.g. fear of human error, inappropriate competence) and e) life-career worries: 7%. The problematic situations at work and ways to solve/ cope up with them have also been dealt with later in this chapter[55].

Interestingly, anaesthetists felt more confident about their future than did other workers. The authors discuss that stress levels can be mitigated by having high authority and high satisfaction in the job[32,33]. In the study, anaesthetists reported high levels of job satisfaction, job challenge, work commitment and empowerment, which in turn may have moderated the stress levels. They conclude by proposing that most of the stressors revealed in their study are things that the hospital and department administration can do something about in their managerial role since the major perceived demands are on work and time management.

Advice and specialist counsellors can support trainees when problems occur. Accident and incident conferences, in which anaesthetists present the critical situations they encountered, could give the opportunity to discharge overload and emotional stress. The simulator, which is increasingly used for crisis-management training, can be used for improving communication and problem-solving strategies.

In **Austria,** Lederer et al[34] have tried to evaluate the relationship between working place conditions and burnout in 89 anesthetists working in the University Hospitals. Working conditions were investigated with the Instrument for Stress-related Job Analysis[35] (ISTA, Version 5.1, short form, Vdf Hochschulverlag AG, ETH Zurich, Switzerland). In their study, workload was assessed as very high by 45 (50.6%) anesthetists, moderately high by 32 (36.0%) and low by 12 (13.5%) anesthetists. Three (3.4%) anesthetists, two males and one female, were diagnosed to have burnout syndrome. All of them were in the same age group (31–40 years). This age group handles stress not only at workplace (high pressure to perform-career / promotion / less seniority) but also handles stress in private spheres (e.g. confrontation with growing children, purchase of property, and death of relatives). Middle-aged persons are very susceptible to develop a "great thirst for life", connected with the fear of having missed something important. Additionally, twenty five percent (23 of 89) of the respondents were found to be at risk of developing burnout syndrome.

Anesthetists at risk for burnout had more physical complaints, greater job dissatisfaction, statistically significant lack of PA scores, and reported a decreased ability of problem solving. Anesthetists not at risk for developing burnout syndrome showed significantly more regulation possibilities at their working place, being able to handle higher complexities in work yet having control over their work at the same time.

According to ISTA, it means that the availability of resources such as one's own influence on work pace and work schedule and the ability to contact and communicate with others at work seems to be an important form of protecting oneself against the development of burnout syndrome. It also has a strong influence on job satisfaction.

Worth noting is their interpretation of DP when they say that it initially serves as a protective mechanism to avoid emotional fatigue but subsequently it impairs the physician/patient relationship.

They conclude with the notion that work environment and job conditions contribute to the development of a burnout syndrome to a greater extent than do personality structure. Hence, prevention of working place circumstances, e.g. change of basic job conditions, are of greater importance in preventing burnout syndrome than are behavioral prevention, e.g. a more healthy behavior of the individual[36].

A **Turkish** survey of 159 anaesthesiology trainees[37] was conducted to understand the reason behind increasing incidence of suicide and burnout among their trainees (14 anaesthesia trainees and residents had committed suicide in the previous 5 years). The survey was based on MBI and Perceived Stress Scale[38]. It revealed that stress was very high in the early years of training.

As the number of anesthesiologists was well below the need in Turkey, nurse anesthetists and anesthesia technicians were the main providers of anesthesia in their country. Regardless of their training, these skilled nurses and technicians were able to handle most of the critical situations without the help of the resident. Lack of control of trainees in their own field was causing feelings of inadequacy and low scores for sense of personal accomplishment.

Perceived stress was decreased in older ages. Ageing and female sex were associated with lower emotional exhaustion and depersonalization scores respectively, and both were associated with higher personal accomplishment. Interestingly, having two or more children was associated with significantly high personal accomplishment but low depersonalization and emotional exhaustion scores.

An **Australian** survey of 422 anaesthesia specialists was conducted[39] to assess the levels of stress and job satisfaction among anaesthesiologists in Australia. Highest reported stress levels were in the ages 41-50 years. Anaesthetists within the ages 30–60 years were able to prioritise home / work commitments better than their younger or older practitioners. Female anaesthetists reported higher stress levels on the visual analogue scale and tended to react to stressful situations by ranting and raving more than male anaesthetists. For them, group cohesion was more important in reducing stress at work and they were also able to prioritise home/work commitments better than the males.

Time constraints (pressure to get lists going on time, arriving early for preoperative assessment of day care patients, working uncertain hours) was the strongest factor contributing towards stress, the most common coping response being discussing the problem with colleagues and partners, or being irritable. Having experienced assistants and better work organization was quoted as the most favoured method to reduce stress in the workplace. Mean stress level of 4.1 and job satisfaction score of 7.1 (scale of 0-10) was recorded by the survey.

Satisfying components of their speciality were providing services of high standard, immediacy of effects and practicality of work. However, the perception about their job being important is getting eroded. The lack of referrals by surgical colleagues and being considered as expenses rather than assets by hospital management teams were cited by many as areas of discontent. The study identified that burnout was not uncommon in the group of Australian-based anaesthetists. It appeared that Australian-based specialist anaesthetists had indicators of burnout that were consistent with other clinical groups, yet at the lower end of the scale for burnout. High emotional exhaustion, high levels of depersonalisation and low levels of personal achievement were seen in 20, 20 and 36% of respondents, respectively.

In **India**[40], about 41.7% of the anaesthetists (total 115 surveyed) felt overworked most of the times and 29.6% felt overworked sometimes. About 50% of respondents felt they were stressed out, though the average daily working hours ranged from 5-12 hours. Although 47.2% were satisfied with their earnings, only 1.7% claimed that they received excellent remuneration while 26.1% believed they received poor remuneration. Almost 60% anaesthetists had a good relationship with surgeons and nearly half of the anaesthetists felt that they did not get due recognition for their services.

Sixty one of the anaesthetists reported spending quality time with the family despite their hectic work schedules. In spite of the stress, overwork and personal sacrifices, an overwhelming number of them (82.6%) enjoyed their work. Common ailments reported were backache (n=19), acid peptic disease (n=14), hypertension (n=12), diabetes mellitus (n=8), depression (n=4) and coronary artery disease (n=2).

The authors conclude by saying that good interpersonal relationships, communication skills and high emotional quotient are required for the practicing anaesthesiologists to thrive and recommend periodic vacation with family to destress themselves. A limitation of this study was that it was conducted on the participants of a conference at a regional venue, and hence may not be representative of the whole population.

In **Nigeria**, 55 anaesthesiologists were surveyed[41] for their levels of job satisfaction and stress. Of the 46 responders, no gender differences existed in job satisfaction or dissatisfaction but the older respondents (age range 40–49 years) were more contented with their job as anesthesiologists. Overall, 27 (58.7%) of the anesthesiologists were satisfied (grade 3–5 on Likert Scale) with their job. While 8.7% were very satisfied (grade 5), 6.5% were very dissatisfied (grade 1) with their job. The hours spent at work per week for anesthesiologists below the rank of consultant was 75–88 h. In the past 1 year, 54.3% had gone on vacation and only 34.8% engaged in one form of sporting activity.

Time pressure (leading cause), long working hours with complaints of insufficient sleep, and employment status (medical officers, residents and senior registrars who had uncertain job future) were the main stressors identified. Of concern was that

21.4% (6 out of 28) registrars would consider opting out of anaesthesia residency program while 32.6% were ready to seek another career if given another opportunity. Stress was managed mainly by praying or seeking spiritual help. The authors conclude by suggesting that having a definite closing time would further enhance their job satisfaction.

A survey in **Finland**[42] was conducted to measure the degree of stress and burnout among 550 specialist anaesthesiologists (328 responded), and consequences of stress among them. A modified Occupational Stress Questionnaire[43], MBI and a series of other questions were used. The mean age of the group was 47 years. Sixty-eight per cent of the working anaesthesiologists felt stressed. Perceived stress increased with workload ($p = 0.02$). The main self-reported reasons for stress were: work (in 64%), combining work and family (48%), health (17%), family (16%), personal relationships (13) and financial issues (12%) among the respondents.

Time constraints, work overload, organization issues and the fear of harming patients were the main "worries at work". On-call stress related symptoms included exhaustion, irritation, yawning, sleep disturbances, feeling cold, memory disturbances and headache. Not surprisingly, there was a statistically significant fall in these symptoms after a two week vacation period. Female gender and younger age group had higher stress levels. On-call workload significantly affected the levels of EE and Burnout, with EE reported by 32% in the lowest and 68% in the highest workload categories, while burnout by 18% and 45%, respectively.

No statistically significant gender differences in burnout were recorded. Being on-call was the most frequently reported reason for perceived sleep deprivation. Alarmingly, almost 25% of the respondents (general population figure of 10%) had contemplated suicide, while 2% had seriously planned it as well. Anaesthetists had high professional efficacy scores, explained by their long careers and good professional skills, thus lowering the overall burnout indicator.

The authors quote that in Finland, suicide (17%) and accidents (11%) were over-represented causes of death among anaesthetists in comparison with other physicians and the general population! An Anaesthetist's time schedule still depended on the schedules of surgeons or other disciplines, lowering their professional control and efficacy.

The study concludes by proposing that interventions are needed to shorten the on-call work period, limit night shifts, and monitor consequences of work-related stress by developing methods for its early detection.

In the **United States of America**[44], a nationwide cross sectional survey of 117 anaesthesiology chairs was conducted to identify potential stressors for their departments and the incidence of Burnout. Almost 59% of the chairs were at a risk of developing Burnout Syndrome. The foremost stress provoking issues for these academic chairs were faculty retention and department finances.

Of the 93 respondents, 34% reported high current job satisfaction, though it fell significantly over the past 1 and 5 years in academic chair position. When their work life balance was assessed, 44% expressed moderate to high dissatisfaction, while only 13% reported the same dissatisfaction levels with their salary. They expressed moderate level of control over their professional lives and viewed their impact in a favorable manner. Of 93 anesthesiology chairs, 26 (28%) met the criteria for high burnout, with an additional 29 (31%) in the moderate to high burnout category. Age, sex, time as a chair, time worked weekly, and perceived effectiveness did not differ between chairs in the high-risk compared with the lower-risk categories.

High-risk chairpersons reported a greater likelihood of stepping down within the next 2 years, demonstrated lower personal efficacy scores, had low current job satisfaction, and were more affected by stressors facing the department. Spouse support scores were also significantly lower in high risk burnout group, with their spouses failing to understand the extra hours of work being put in by these chairs. Decreased current job satisfaction and low spousal/significant other support were identified as independent predictors of a high risk of burnout in this study.

Stress related to budgetary concerns, faculty retention, and accreditation/compliance issues associated with the residency program were among the largest sources of stress. Of special concern here is the fact that anesthesiology chairs exhibited a higher rate of burnout compared with chairs of obstetrics/gynecology[45], otolaryngology[46], and ophthalmology[47] in similar studies. The degree of depersonalization and emotional exhaustion was higher in anesthesiology chairs than in chairs of these departments. The importance of suitable mentorship in handling stress and administrative challenges has also been discussed[48].

The authors support the conviction that physicians who cultivate their personal and professional well-being are less likely to develop burnout or will at least diminish its impact on their lives[49]. The development of well-being should be stimulated throughout one's career, always being careful to minimize the delayed gratification mechanism used so frequently by physicians[50].

In **Canada**, a survey of 945 anesthesiologists was conducted[51] to assess the overall job satisfaction among anesthesiologists. Perceived surgeons' and patients' attitudes towards anesthesiologists were also analysed. 75% of the respondents rated their job satisfaction highly (graded 4 and 5 on Likert scale). 10% of the anesthesiologists were totally satisfied, whereas 1% of the sample were totally dissatisfied. Average hours at work per week were 59 ± 12 hr.

Job satisfaction among anesthesiologists was significantly associated with intellectual stimulation, good quality of patient care and interaction with patients. Comparing staff anesthesiologists and residents, the residents were more satisfied overall. There were no significant differences in satisfaction between genders or between

older and younger anesthesiologists. Commitment to any sub-speciality of anesthesia e.g., chronic pain, ICU, etc. was not associated with a significant increase in overall job satisfaction.

Only 45% of respondents felt highly regarded by surgeons, significantly affecting overall job satisfaction. Those who felt highly regarded by their surgical colleagues reported 87% overall satisfaction compared to 65% of those who did not (P=0.001). 63% of respondents believed patients recognized anesthesiologists as medical doctors. Again, perception of patient appreciation of the anesthesiologist's status as a medical doctor resulted in higher levels of overall job satisfaction (82 *vs* 63%, P=0.001).

The authors conclude that increasing intellectual stimulation, allowing better quality of care, improving interaction with patients and providing adequate operating room assistance should enhance job satisfaction. This would translate into a reduced incidence of Burnout among Canadian anesthesiologists[28,32,33]. Enhancing the way in which anesthesiologists are regarded by surgeons by improving communication, identifying areas of dissatisfaction and correcting them should also, in the long term, contribute to increased professional satisfaction among Canadian anesthesiologists.

In **Brazil**, a survey[52] was carried out to assess and compare the perception of quality of life between anaesthesiologists and non-anaesthesiologist physicians working in the capital, as well as the different city hospitals of the state of Rio Grande do Sul. Three specific questionnaires, including the World Health Orgaisation-Quality of Life Group (WHOQOL-BREF)[53] were used.

Anaesthesiologists had significantly lower scores compared with non-anaesthesiologists in the WHOQOL-BREF tool on the following domains: physical, psychological, social relationship, environment and general quality of life. It was evident that their "quality of life" was inferior in many aspects of the analysis. A reduced participation in scientific events, worst relationship with staff and less time of graduation were significant factors observed in the survey.

The study highlighted a significant impact of the surgeon's attitude towards the anesthesiologist and his professional satisfaction, a result also supported by previous study[51]. Social relationships (more reading time, making friends, family relationships) have also been shown[54] to mitigate stress, when it was seen that such anesthesiologists trust more their personal and intellectual skills to handle daily demands, overcoming even the support of colleagues or bosses.

In **Sweden**[55], a qualitative study was carried out to ascertain the difficulties at work from anaesthetists' own perspective and to examine how anaesthetists handle and cope with situations that are perceived as difficult and potentially stressful.

Interestingly, the interviews revealed two main categories of ways of handling difficulties by the anaesthetists. First method consisted of actually trying to solve the problem, while the second method was of finding a coping strategy that minimized

stress, despite the problem not being solved. Main problems identified were the inherent difficulties in anaesthesia like difficult cases or situations, making ethically difficult decisions and lack of respect from other doctors/surgeons.

Various problem solving strategies described were simplifying the work in hand, prioritising it and starting from the most obvious and simple task, seeking support from colleagues, delegating work and having a good communication with surgeons and staff. Coping strategies described were accepting difficult situations as part of one's work, recognising one's own limitations (individual competence and of the healthcare system), saying "no" to excessive demands and limiting the task one can take up safely.

The authors conclude that there is ample evidence that the anaesthetists' work is difficult and potentially very stressful. Hence, they need well-functioning coping strategies. Anaesthetists, especially the young consultants of today (work time directives limiting their total clinical exposure in their training years) sometimes may not have the expertise necessary for some of the difficult cases that they will encounter at work. They therefore have to develop their ability to cope with uncertainty and error, a personal quality that belongs to professionalism[56]. Young physicians should also be helped to develop into specialists who are content with their work. Enjoying work promotes the well-being of doctors and their patients[57].

At the World Federation of Societies of Anaesthesiology **(WFSA), The Professional Well-being Committee (PWC)** is actively involved in research and development of methodologies to promote well-being at work among anaesthesiologists across the world.

In the spring of 2010, the PWC conducted an investigation[2] involving 120 member-societies of WFSA, using a questionnaire, whose objective was to identify the incidence of occupational health problems among the members of a specific society and the approaches used by those societies to treat the occupational health of anesthesiologists. Results showed that more than 90% of National Anaesthesia Societies considered the Burnout Syndrome as a problem among their members, but only 14% had developed some sort of strategy to face it.

The PWC of WFSA also organized a special session on "Professional Well-being in Anaesthesiologists" at the World Congress of Anesthesiologists, 2012 at Buenos Aires, Argentina. Topics covered included suicidality, chemical dependence, ageing and burnout among anaesthesiologists. The need for creating awareness on Burnout and stress in our profession, as well as coming up with laws/recommendations/legislations with help of world organizations and enforcement bodies (WFSA, WHO, ASA, central-provincial governments, etc) was discussed.

Conclusion

Burnout Syndrome in Anaesthesiologists is fast coming up as a significant challenge, with its prevalence considered to be around 20-50 % worldwide. Burnout has been preferentially seen in occupations involved with human care. Anaesthe-

siologists by professional conditioning appear to be a vulnerable group. They feel obligated to respond to majority of patient care requirements in the perioperative period, seldom getting credit for the same. The increased work demands in face of unmet gratitude from both patients as well as clinical colleagues manifest as stress and burnout in the anaesthesiologists.

Depersonalization has been used as an important component of Burnout by Maslach and colleagues in framing the Maslach Burnout Inventory. However, we feel that a fine line exists between being considerate towards our patients' safety on one hand, and in going overboard and being overtly attached with one's work towards the patient.

Expecting rewards or gratitude after intimate involvement comes naturally, and so does stress from unmet expectations. Being rigid, cynical, over sincere, perfectionist and emotionally attached with patients under our care may actually result in "Personalization" and develop into Burnout over time. Hence, to an extent, being safe at work and working with a "neutral approach towards one and all" is proposed here as one of the means to counter burnout.

Having an unbiased, impersonal response to most of the anesthesia work, including preoperative assessment, planning, execution, procedures, post operative management and handling of critical events, without negatively inflicting harm to the patient is proposed. When one's care is delivered without emotions, ego, self-esteem or pride, results may actually turn out better for the patient as well as the treating clinician.

A limitation to this "Personalization" theory may be the observation of high incidence of burnout in young anesthesia trainees who may not appear to have yet worked for sufficient time in anaesthesia to accumulate stress. A combination of low personal accomplishment, critical incidents and lack of adequate social/professional support may precipitate burnout faster in such population.

Lack of maturity (personal coping resources) in the young trainees and the thrill to do complex tasks independently may frequently push them into high risk situations, adding to their stress levels and ultimately, Burnout. Hence, we advocate that it's time to move away from "Personalization" model to actually one of "Depersonalization". Development of tools and surveys with negative correlation of high points in "Personalization" as a component of Burnout rather than Depersonalization would be an appropriate step in this direction.

Most of the studies surprisingly reveal that the anaesthesiologists have a high job satisfaction and are a contented lot. However, lack of control over ones work and lack of organization at work place account for significant stress and burnout among anaesthesiologists. Role of communication, teamwork/camaraderie with colleagues and nursing staff, availability of skilled assistance, and most importantly, intervention by management people to improve and organise working conditions for the anaesthesiologists appear to be some recommended measures.

Men appear to have a higher level of empowerment and control over risks, while women are seen to have a higher incidence of emotional exhaustion , manifesting as higher tendencies towards Burnout. If any speciality, e.g. Anaesthesia tends to have a majority of women entering the speciality than the number of men, it could potentially tilt the numbers in favour of a higher incidence. Hence, it may be prudent to direct more resources, social support and initiatives towards rehabilitating female anaesthetists and prevent the increased prevalence of Burnout in our speciality.

Summary

To summarize, a new term "Weingology" has been coined to promote importance of this subject in the currently demanding work environment. Weingology is all about moving away from a negative "Burnout Model" towards one of healthy encouraging "Job engagement". Studies which can help us come up with interventions to reduce daily administrative work hassles, give us better control over our time and work, as well as promote a positive environment of job engagement are urgently needed. "Personalization Theory" has been proposed here as a hindrance to work freedom, and that Depersonalization may actually be beneficial! National policies to prevent and handle the Burnout Syndrome and related pathologies in health care professional must be developed.

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Measuring Professional Well-Being Among Anesthesiologists: Conceptual Structures And Attributes Of The Instruments

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Subjective well-being as an affective state

The classical definition of subjective well-being includes the concepts of happiness and satisfaction with life. In a broader sense, subjective well-being depends on pleasurable experiences, low levels of negative moods (anxiety, frustration, depression, for example) and high levels of satisfaction with life. Positive experiences encompassed by the classical concept of well-being are the elements that make life a rewarding experience.

Elaborating the classical concept, Diener and colleagues developed a 5-item scale designed to measure satisfaction with life[1] with possible scores between 5 and 35 points. In research involving american citizens, scores above 25 points indicated higher levels of satisfaction with life then the average population.

Research based on the classical concept has shown that predictors of greater happiness: living in a rich country and having resources to achieve personal goals. Other determinants of subjective well-being include temperament characterized by low levels of worry, the ability to develop realistic and meaningful personal goals, strong social relationships and positive personal outlook[2]. Several domains have been shown to encompass the major components of subjective well-being, as shown in **table 1**[3].

We conclude, therefore, that the subjective well-being, more than happiness and satisfaction with life itself, includes several facets, grouped in at least four domains. Moreover, the concept of well-being can also be seen from the point of view of different activities and personal situations of the individual, such as work, family life, aspirations, health, finances, etc. This complex structure characterizes subjective well-being as a broad and multifaceted concept, demanding several domain-specific measures to address the various sub-constructs encompassed by the construct.

This chapter focuses on measures of subjective occupational well-being.

Table 1. Components of subjective well-being

Pleasant affect	Unpleasant affect	Satisfaction with life	Domain satisfaction
Joy	Guilt and shame	Desire to change life	Work
Elation	Sadness	Satisfaction with current life	Family
Contentment	Anxiety and worry	Satisfaction with past life	Leisure Health
Pride	Anger	Satisfaction with future	Finances
Happiness	Depression	Significant others' views of one's life	Self
Ecstasy	Envy		One's group

Occupational Well-Being

Unlike the classical view of subjective well-being as a purely affective process, researchers have also incorporated non-affective dimensions into the concept of well-being. These dimensions, as behavior and motivation, increased the spectrum of the construct, allowing for the development of broader conceptual frameworks describing occupational well-being. The main models that incorporated non-emotional dimensions to the concept of subjective well-being were those of Ryff and co-workers[4], Warr et al[5] which are briefly described below.

Ryff's model of subjective well-being

Ryff's model of subjective well-being is context-independent. It was created based on multidimensional conceptual structures of positive psychological functioning. It identifies six dimensions of wellness:

1- self-acceptance: the individual has a positive attitude towards himself; recognizes and accepts his/her multiple aspects, including good and bad qualities; feels positive about past life experiences;

2- positive interpersonal relationships: the individual has a satisfactory trusting relationship with others, is concerned about others well-baing, is capable of strong empathy, affection and intimacy; and understands the give and take nature of human relationships;

3- autonomy: the individual is self-determined and independent, is able to resist social pressures to think and act in certain ways, regulates behavior from inner convictions, and bases self-assessment on personal standards;

4- environmental mastery: the have a sense of mastery and competence in managing the environment, controls complex array of external activities, makes effective use of surrounding opportunities, is able to choose or create contexts suitable to personal needs and values.

5) goals in life: the individual has goals in life and a sense of direction, feels that there is a meaning to the present and past life, has beliefs that give life purposes, has goals and objectives for his/her existence.

6) personal growth: the individual feels him/herself in continuos development, growth and expansion, is open to new experiences, aims to accomplish his/her own potentials, sees improvement in his/her person and in behavior over time, is constantly changing to reflect a changing image of self-knowledge and efficacy.

Warr's model of occupational well-being

Warr and colleagues[6] focused the creation of their model of wellness on the occupational domain. For these authors, the concept of occupational well-being is intertwined with mental health in the workplace and has four primary dimensions: affective well-being, aspirations, autonomy and competence. A fifth secondary dimension named integrated functioning, covers the primary dimensions and reflects the functioning of the whole person.

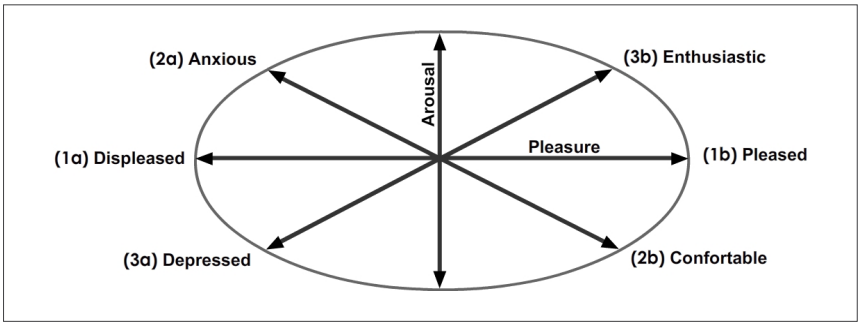

Figure 1. The main axes for the measurement of affective well-being

The *affective well-being* expresses feelings, measured as opposites on the extremes of the scales, for example good or bad. Another dimension has been identified in some studies and named *arousal*[7]. Of the dimensional axes representing affective well-being, the pleasure-displeasure axis seems to be the most influential. Arousal does not correlate with other axes of the construct[8], so that is not taken into account in measures of affective well-being. *Aspiration* is a concept related to intrinsic motivation and refers to the individual's interest for his work. At its most positive extreme, it is characterized by the individual's willingness to seek increasing challenges within the occupational environment. In its most negative form, it is represented by apathy and conformity with the *status quo* of the occupational environment. *Autonomy* refers to the ability of the individual to keep and follow his/her opinions and beliefs within the workplace, resisting to opposing pressures. *Competence* refers to the individual's ability to deal with problems in the workplace and to remain effective despite adversity.

Environmental factors also influence occupational mental health. Nine groups of factors were identified by Warr et al[6]:

1- opportunity to control the work itself
2- opportunity to use own skills
3- externally generated goals
4- variety of work content and location
5- clarity of information at work
6- availability of money and material resources
7- physical security
8- opportunities for interpersonal relationships
9- social and professional value

These environmental factors, according to Warr, act as promoters of mental health in the workplace up to a certain point, after which the effect becomes constant. Some factors when operating at higher intensity than desirable can negatively influence worker's mental health. In an analogy to vitamins, Warr exemplifies factors that such as vitamins A and D, which taken in excess can cause serious side effects, in contrast to vitamins C and E which, even taken in higher does do predispose individuals to serious toxic reactions. He classifies factors as AD (additional decrement) as those causing decreasind mental health after a given point in time, and CD (constant effect) as those factors showing a nadir after stabilization. Both kind of environmental factors are non-linearly related to mental health. Among the environmental factors listed above, only (a) the availability of money and material resources, (b) physical security and (b) social and professional value were classified as CD factors. A typical curve environmental factors - occupational health curvilinear relation is depicted on **figure 2**.

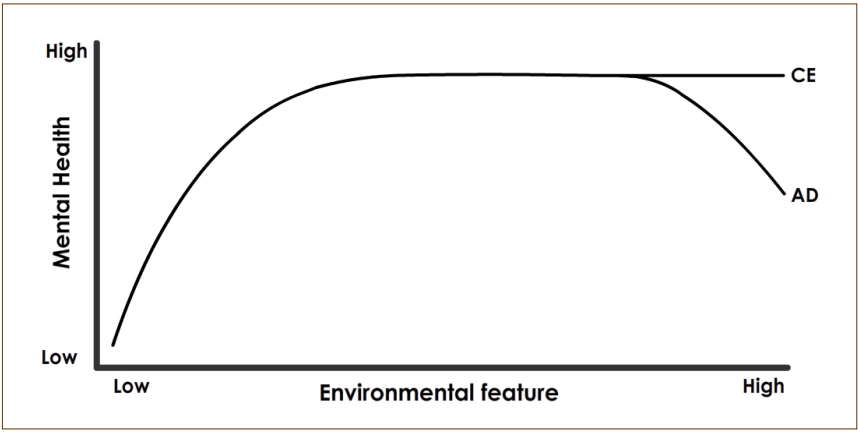

Figure 2.

Van Horn's model of occupational well-being

Van Horn and colleagues[9] developed a conceptual model based on Ryff's and Warr's models. Van Horn's conceptual framework of occupational well-being includes five domains: emotional, professional, social, cognitive and psychosomatic. Confirmatory factor analysis showed that these dimensions reflect a more general underlying concept. Based on this model, the authors concluded that the occupational well-being is actually a broad concept consisting of different facets that form the conceptual core.

Measuring occupational well-being

In medicine, research on occupational well-being has been directed mainly to the investigation of the prevalence of mental disorders among health professionals. Depression, alcohol and drug use, mood disorders, suicidal tendencies, and extreme fatigue syndrome (burnout) have shown variable, but significant prevalence among doctors and other healthcare professionals[10]. Emotional exaustion has been especially prevalent among anesthesiologists and anesthesiology residents[11]. However, as described above, occupational well-being is a much broader multi-faceted concept. Currently no instruments are available to reliably measure anesthesiologists occupational well-being. This section aims to describe the main elements of the development of measures of occupational well-being.

Research Design

The planning process should involve four phases, each represented by a question[12]:

1- Determination of researcher's/user's needs: what fundamental questions must be addressed by the research? At this stage, determine which construct, abstract concept or latent variable will be the focus of the instrument.

2- Analysis: what kind of statistical analyses will produce meaningfull answers to the study questions? - at this stage, the researcher must determine what type of analysis will be more appropriate. This step is crucial, since the types of scales, the sample size, and relevant covariates will be determined at this step.

3- Data extraction: what kind of data should be extracted and how will they be tabulated to allow for the proposed analyses? - At this stage, the types of variables and their ranges should be determined and any transformations programmed to allow the use of data so as to obtain valid and reliable results from the programmed analyses.

4- Items: which questions need to be created to elicit the data required for the solution of the main issues of the study? - This phase is crucial and should be performed with appropriate techniques, such as focus groups[13] and the Delphi method[14-17].

Psychometric Indicators

Two core psychometric indicators should be investigated when creating or reporting an assessment tool: reliability and validity.

Reliability

Reliability takes different forms:

a) internal consistency, or reproducibility. The results are reproducible when applied to similar samples. The Cronbach's alpha is a classical measure of internal consistency of an assessment instrument;

b) test-retest reliability ensures that the measurement is stable when applied on different occasions;

c) interrater reliability: the measure is not dependent on raters, but is capable of yielding highly correlated results when applied by different examiners simultaneously.

d) parallel reliability, the correlation between two forms of the same instrument, applied to different populations.

Validity

In addition to face validity and content that are determined from the analysis of the instrument by experts prior to its application, other forms of validity can be estimated:

a) convergent validity: the instrument produces measurements strongly correlated with those obtained by other instrument designed to measure the same construct.

b) discriminant validity: the instrument is able to discriminate between different constructs;

c) predictive validity: the measure produced by the instrument is capable of predicting outcomes.

The robustness of the measuring instrument depends on how strong are its psychometric measures of performance.

Conclusions

Occupational well-being appears to be a single construct, composed of facets related to affection, social competence, physical health and intrinsic motivation. Currently, anesthesiologists' occupational well-being cannot be measured, given the lack of specific multi-dimentional tools. The construction of such an instrument should follow the technical procedures recommended by psychometric theory.

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Anesthesiology Residents – The importance of occupational well-being

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Introduction

Quality of life is currently considered a priority in developed countries. Brazilian means of communication highlight the importance of lifestyle changes for a healthier life. Therefore, innovative and systematic programs are being created in order to prioritize health and human well-being[1,2]. In this process, preventive measures related to doctors' occupational health have been studied as it's known that medicine causes physical and mental stress that may compromise professionals' quality of life and performance.

However, when it comes to anesthesiology, the concern about psychopathological disorders secondary to a stressful routine does not get enough attention. Most anesthesiologists cannot balance their professional concerns, personal life and doubts about the future.

New areas of expertise in anesthesiology are stimulating and professionals tend to look for financial rewards and status in the short term. Although there is a positive financial return, quality of life among anesthesiologists is way below the one seen in other medical specialties[3]. Young anesthesiologists tend to absorb their supervisors' routine and values in an attempt to adapt. Considering professional satisfaction is translated into happiness and well-being, so the aim of this chapter is to discuss principles of medical well-being, especially among anesthesiology residents.

Development

Impact of the problem and determinant causes

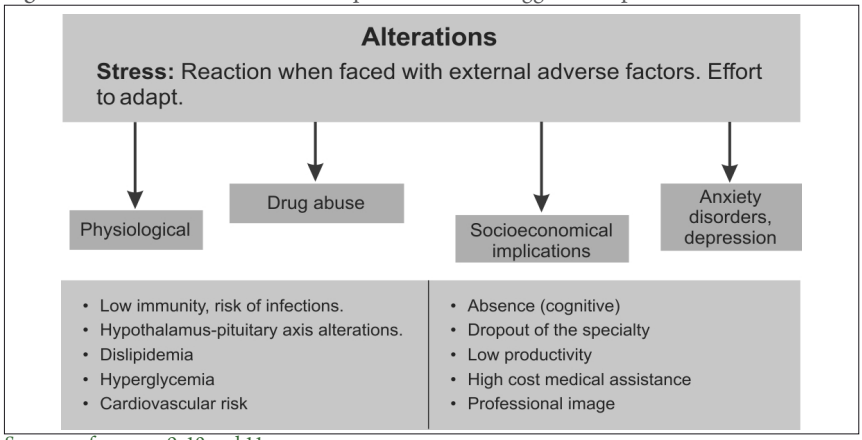
According to WHO, quality of life is an individual perception, based on culture and values, that considers one's past experience and future goals. Anesthesiology residency causes many sudden lifestyle and behavioral changes that may result in severe physical and mental crises, depending on the resident's level of emotional maturity and resiliency. **Frame 1** presents possible triggers and effects of a resident's effort to adapt.

Frame 1: Causative factors
• Long journeys of work • Complexity of patients illnesses and surgeries • Activities that demand a higher level of knowledge • Ethical matters in human relationships • Malpractice • Lack of support from tutors/emphasis only on practical skills • Outdated staff • Health: sleeping and eating disorders, viral infections, repetitive strain injury, work-related musculoskeletal disorders, hand injuries, ankle sprains, and fractures of the foot, ankle and forearm. • Possible accidents, inappropriate safety and ergonomic conditions. • Exposure to harmful agents: physical (light, noise, temperature, humidity, radiation), chemical (organic, inorganic, waste and volatile agents) and biological (viral, bacterial, protozoa). • Virtual reality (social networks). • Concentration difficulties, memory lapses. • Doubts about the future and choice of specialty; psychological distress (stress, anxiety, depression, drug addiction, and burnout). • Demoralization • Lack of professional satisfaction; sense of obligation.

Sources: references 1, 3, 4 and 5.

Resilience is the ability to healthily adapt to stress with minimum physical and psychological consequences for goal achievement. According to several authors, it is recommended that anesthesiology residency[6] programs have criteria for early detection of increases in acute/chronic fatigue and occupational stress during clinical practice. Programs should also study possible ways to increase resilience[7] and medical[8] well-being.

Figure 1 – Effects of stress and consequences of the struggle to adapt

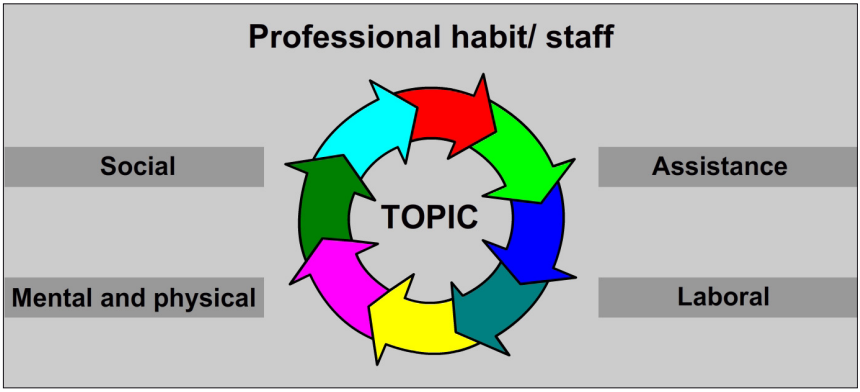


Source: references: 9, 10 and 11.

Behavioral and emotional symptoms require early recognition and prompt intervention. Current working models and relationships should be reviewed so that changes can be made in order to improve professional satisfaction and reduce economical, political, social, environmental and cultural possible crises.

Figure 2 provides a representation of the main determinants of an anesthesiologist's *modus operandi*. Ideally, each reader should select one specific topic from the circle and start preventive changes in his workplace to minimize biopsychosocial risks for the entire team.

Figure 2 – Anesthesiology residents' technical epidemiological nexus of/about health and well-being.



Burnout

It's a chronic occupational stress syndrome comprised of negative attitudes and feelings (**frame 2**), currently considered a"human-work relation blockade". This syndrome was named first by Freundenberg[12] through the social-psychological view of Christine Maslach[13] author of the Maslach Burnout Inventory. The burnout syndrome includes problems related to profession and work. It's common in professionals that deal constantly and directly with human relations, especially when the professional has the task to help people (doctors, nurses, teachers, judges, policemen). Association between work conditions, physical illness and mental disorders has been studied for decades, but clinical correlation is still small. According to the review of Benevides-Pereira[14] the incidence of burnout varies from 30 to 47% but the reported incidence in Brazil is only 10%, which implies lack of active investigation as "it will only be found if it's sought".

Frame 2 – Burnout – Triad
I Emotional Exhaustion • Intense fatigue/ emotional breakdown • Higher perception of demands • No stress resistance
II Depersonalization • Emotional detachment/ low social cohesion • Work indifference/ loss of respect to the patient • Loss of focus • Loss of identity
III Professional Effectivess • Lack of future perspective • Frequent frustrations • Feeling of incompetence • Low self-esteem

Source: references 11, 12, 13, 14

Burnout and Depression

The individual who suffers from chronic fatigue is easily labeled as depressed. In fact, there can be an overlap between depression and the symptoms seen in the burnout syndrome (stress, anxiety)[15,16].

Current cultural demands of success, beauty, happiness and joy may worsen depression symptoms. These things that should be a possibility become a social obligation[1] and the world expects life to be a never-ending party. In this context, depressed individuals tend to live in a bubble and feel rejected. These feelings start a cycle in which bad thoughts bring up even more bad thoughts and it's necessary to avoid ideas that "my work will never be finished in this operating suite because there will always be another patient in line".

Differences between burnout, stress and depression

Burnout: depression seen in this situation is temporary and caused by one specific factor in life (work). It may be associated with continuous stress; however it does not mean that excessive stress was the cause. The onset of depression is slow and subtle and may be underestimated, making differential diagnosis difficult[15,16]. If present, guilt tends to be more rational. Individuals can realize that their indecision and inactivity is caused by fatigue. Initial insomnia is more common.

Stress: individuals can keep things under control and feel energized by the accomplishment of a task; however stress can trigger a harmful cycle that compromises professional training.

Depression: guilt feelings compromise all areas of the resident's daily life. Terminal Insomnia is common.

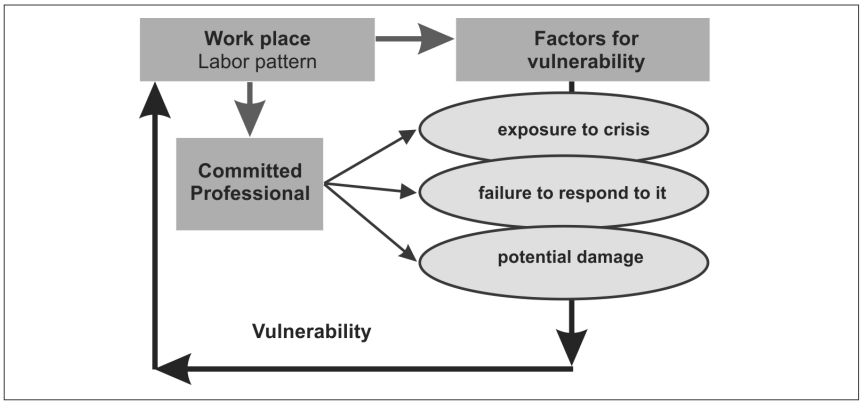
Frustration at work may cause isolation and mental disorders that lead to unhappiness. According to Turkle[17], solitary people tend to idealize human interaction through virtual relationships. Although internet represents a way to express feelings, interests and beliefs, it secludes the individual from real interactions.

Iacovides and colleagues[18] believe that burnout is not related to one specific profession, but to the way people see and organize their work. Others[19] claim that the main cause for burnout is the sum of a committed person with the impossibility to achieve a goal as it was idealized. In this context, it's necessary to understand the concept of vulnerability[20] as a combination of risks that will contribute to the psychosocial risk of burnout.

Vulnerability

- Risk of exposure (crisis situation).
- Risk of failure (absence of enough knowledge or resources to proceed).
- Risk of potential damage (serious consequences as a result of the crisis).

Figure 3 - Determinants of Vulnerability



Source: adapted according to references 18, 19 and 20

Labor pattern

Anesthesiology residents are exposed to a lot of stress while in training, so it's essential that they find solidarity and appropriate human support.

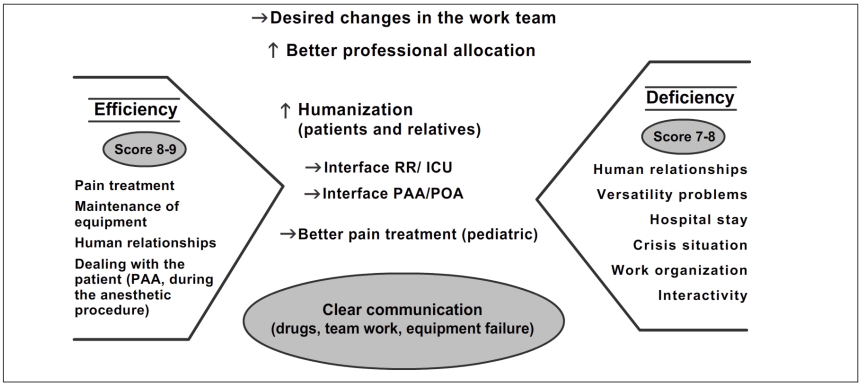
A strategy for early recognition of occupational stress must be planned, widespread and adopted by the entire work team[21,22]. However, many professionals deny their responsibility towards residents and believe that only the chief of residency should be responsible for residents' management and well being (education, assistance and people management).

Psychosocial vulnerability is reinforced when bureaucratized institutions create labor patterns that limit anesthesiologists' decisions over drugs, exams, time of appointments and hospital stays[20].

Continuous evaluation is necessary for the development of good professionals that trust their own work and recognize the importance of patient safety. Quality of equipment, environmental infrastructure, teaching and human interactions are related to the quality of professional relationships and per operative work.

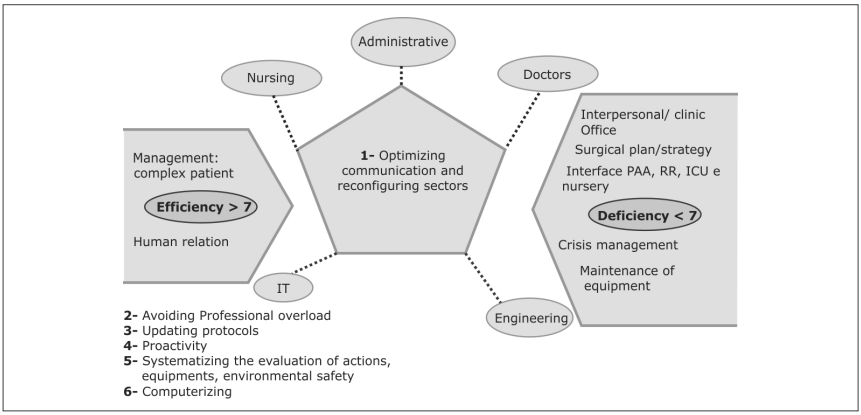
Figures 4, 5 and 6 summarize evaluated factors and results from surveys[23,24].

Figure 4 – Update Workshop of Inter-Relationship in the peroperative period



PAA (preanesthetic assessment), POA (post-anesthetic assessment)
RR (recovery room), ICU (Intensive care unity)
Note: important factors related to low scores are associated with organization and improvements in task division, time and duration of work journeys, hierarchical structure.
Source: references 23, 24.

Figure 5 - Symposium: Optimized inter-relations in the peroperative period. General results: Proposals for changes in shared responsibilities.

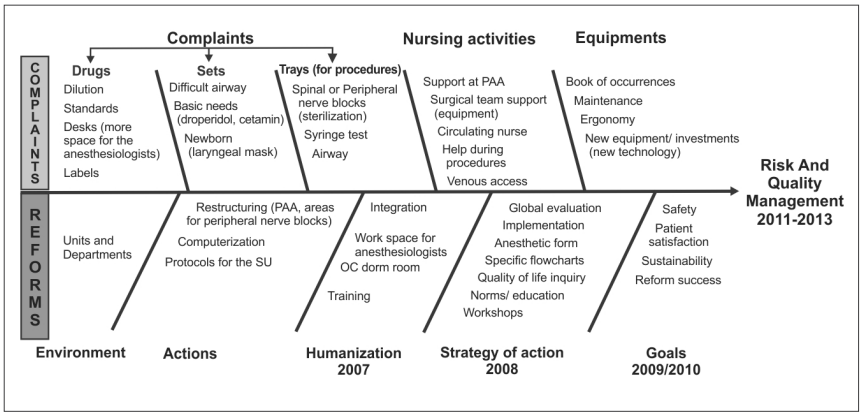


PAA (preanesthetic assessment), POA (post-anesthetic assessment)
RR (recovery room), ICU (Intensive care unit)
IT (information technology)
Rating scale from 0 to 10.
Source: reference 24

The workshop was a meeting to debate problems that affect the quality of work in the peroperative period. The pentagon illustrates the six main factors that should be sought.

Ishikawa studied anesthesiologists' critical comments and, based on that, illustrated a prospective reformation (2006). Anesthesiologists' complaints are presented at the upper portion of **figure 6**. After the survey, in order to improve safety, multidisciplinarity and sustainability of services and optimize system organization, the main corrective measures were defined and listed at the bottom axis.

Figure 6 - Prospective reform founded in critical comments

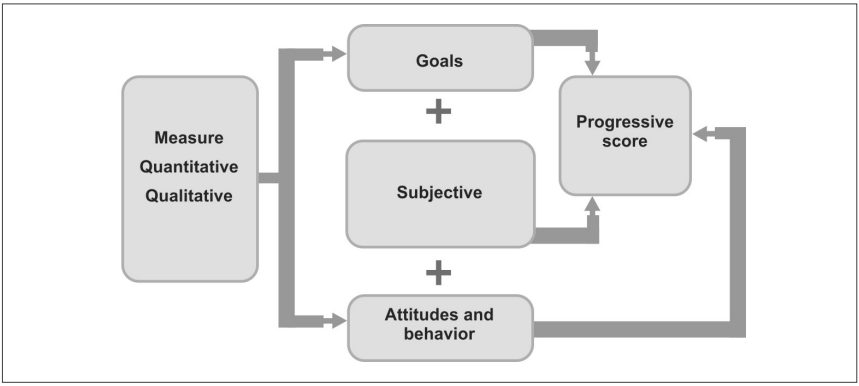


PAA (preanesthetic assessment), SU (surgical unity), ASU (ambulatorial surgical unity), OC (obstetric Center), RX (radiology), HD (hemodynamics), PARR (post anesthetic recovery room), Radio (radiotherapy)
Source: reference 23.

Questionnaires and multidisciplinary workshops brought up important reforms that improved professional quality of life and confirmed the importance of the presence of the anesthesiologist inside the room in the peroperative period.

But one important factor was not investigated: anesthesiology residents' well being. Overall, this is evaluated by the development of residents' (**figure 7**) skills, knowledge, behavior and relationships.

Figure 7 – Criteria used to prospectively evaluate the training process of residents in different areas of expertise.



Qualitative, cultural, behavioral and action scores represent the sum of different areas of training and learning process under the supervision of anesthesiologists, nursing and administrative personal.
Source: Teaching Forum: How to evaluate and learn anesthesiology nowadays.

A complimentary approach focused on performance and perception of quality was made through interviews and inquiries. Having gathered that information, the status of the anesthesiology residency at the *Hospital das Clínicas de Porto Alegre (HCPA)* was illustrated.

In summary, resident's unsatisfactions are, as expected, related to overload, extreme fatigue, poor relationship with surgeons, anxiety, lack of time to study, rest, sleep and leisure and inadequate diet.

Another study (**Table 3**) identified levels of occupational stress and working conditions of Brazilian residents.

Table 3 - Study of Relationship Among Occupational Stress Level and Work Conditions: in Anesthesiology Training Programs in Brazil

- Second year of training in Anesthesiology presented the highest rates of occupational stress compared to other levels of training;
- Occupational stress levels were higher in females;
- Occupational stress was higher between the ages of 25 and 35 years;
- Married group presented a lower level of stress compared to unmarried and divorced groups;
- The number of hospitals in which residents have their clinical activities did not affect occupational stress;
- Alcoholism was highly prevalent in Brazilian residents and preceptors.
- Levels of control over work dynamics, analyzed in five dimensions; showed a statistically significant lower level of occupational stress.

Source: reference 6.

Important changes for the apprentice are being made thanks to modern pedagogical tools in laboratories, online and simulation on mannequins. Multiple possibilities are available to improve anesthesiology residents' knowledge, psychometric and practical skills [25,26].

International researchers have been studying about the importance of emotional intelligence, behavior and attitudes – attributes required in critical situations and high pressure work environments[27]. But Brazilian residency programs still have many problems to solve, especially in the matter of apprentice support during behavioral and existential problems [28]. Recognition of physical and mental risks should be part of the learning process to avoid the negative cycle illustrated in **frame 1**.

Preceptors or supervisors must be valued as important agents in the early recognition of repetitive behaviors, absence of physical, mental and moral strength; factors that may trigger emotional damage and risks for occupational injuries or illness. Moreover, leadership is needed to achieve an individualized model of supervision, beyond the current available "single model", as if people were all alike. It is essential to create a system of support, especially during the transition from the 1st to the 2nd year of residency and then in the end of the 3rd year. The analysis of initial plans and final accomplishments is necessary for an effective closure of the learning cycle.

Althought it's known that residents present a high biopsychosocial risk, little has been done to change that. The transformation of an apprentice into an anesthesiologist should be assessed not only by his technical skills, but also by affective-cultural abilities.

"... and to listen to stories – the liberal's dogma – skepticism must be forgotten." Umberto Eco. A ilha do dia anterior. 3ª Ed. 1995.

If there is no real concern about the adverse environment present in anesthesia residencies it will not possible to keep updated in this unlimited and technological future[30].

Recommendations

- Redefining coordinators' attributes and start behavioral approach.
- Analyzing the frequency and psychosocial causes of classic symptoms of fatigue.
- Exploring individual resilience and implementing measures that protect residents' well-being by respecting this individual's resilience.
- Debating the subject. Respecting working-hour limits.
- Satisfactory infrastructure.
- Inquiries and interviews should be made periodically to identify advantages, disadvantages and difficulties at work. Annex 2 describes items addressed to preceptors.
- Specifying exactly what is intended with the evaluation. Defining desired attributes.

• Feedbacks are much more than criticism. They help professionals recognize their flaws and vulnerabilities at work.

• New areas of expertise in anesthesia demand more practical skills and training and the evaluation process should include parameters related to residents' well-being.

• Intervention in order to solve a reported problem increases safety and satisfaction at work.

• Preceptors of different ages should work together in order to recycle some concepts and recognize the benefits of a new model without disregarding old concepts that were once used (**Figure 8**).

Figure 8. Anesthesiologist Profile

Traditional	Current
Loyalty to the institution	Loyalty to self
Search for stability	Search employability
Medium level of self-confidence	High self confidence
Focus on salary and status	Does not expect to stay in the same job for too long
Long-term career plans	Focus on personal growth, financial opportunity
Dream of a balanced life	Need for a balanced life
Fear of change	Changes are part of evolution
Resistance to new technologies	Use of new technologies
Long working journeys	Result-based evaluation
Dependency on leadership	Requires consistent leadership
Hierarchical govern	Without a competent leadership, they may quit the job
Motto: Work hard X success	Good work, enjoy work, overcoming
Organizational leadership: intuitive concepts	Training in hospital management
Social and/or policies changes increases physical and emotional stress	Deals better with the new times.*

Source: * reference 29.

Remember

• Time brings changes and the ideals of an anesthesiology service should be always updated, as well as all residency preceptors.

• Knowledge and new ideas are the result of experience and young spirit combination.

• Quality of life analysis provides indicators that can be used by the SBA (Brazilian Society of Anesthesia) Commission of Occupational Health to defend anesthesiologists' interests before medical organizations.

• Campaigns to minimize stress factors at the hospital should be started.

- New times demand a better multidisciplinary integration; experiences and knowledge trades between different specialties and an open mind are essential for the establishment of professional partnerships and better clinical teams.

Conclusions

This chapter does not focus on the biopsychosocial vulnerability of anesthesiologists, but intends to make the reader think about what is happening in his work environment, what can be done and who may be affected. It is time that the entire educational community of Anesthesiology Societies work together in order to intervene in a convergent and harmonious way. It is necessary to understand that nowadays professionals are in high demand and that the need of "more production, less time" may distort the educational background of residency.

The use of residents to fulfill the lack of assistant doctors should be avoided.

In more than half a century of medical residencies, Brazilian schools of anesthesia are still homogeneous and cultivate respect to the old generations, despite world changes. Thus, anesthesiology training programs must keep improving.

Annex I – Qualitative analysis about anesthesiology residents well-being: structured and individualized interview

- How is your life?
- Describe how you see your work environment and communication level
- How about your preceptors?
- How about your technical skills?
- Knowledge?
- What are the most important topics of knowledge?
- How are your emotions and satisfaction levels?
- How's your concentration?
- What are the anesthesiology techniques that you mastered and feel confident about?
- What about monitoring?
- Describe how you see values, norms and expectations inside your residency.
- Evaluate your training for crisis management.
- Evaluate your knowledge and management of anesthesia equipment.
- Balance your work with and without supervision
- Would you consider your residency good, stimulating, satisfactory and organized?
- Free topic: suggestions and critics.

Dear Colleague

This survey is designed to collect information from faculty aiming to expand technical, pedagogical and psychosocial resources for the training process of the anesthesia residents and anesthesiologists.

I- Objectives:

- Reflect on current teaching practices and preferred approaches to medical residency;
- Identify strengths (that made the experience positive) and problems in the progression of the trainings offered in different areas of care of the formal program;
- Recognize facets of the inter - relationship / interaction with components of clinical staff that add curricular to outcomes;
- Compare the results with other centers, using feedback for effective critique of participants centers.

II- Questions for Reflection (no correct answer):

Considering that you are a faculty member of an anesthesia residency program:

1. What do you find most rewarding in your job?
2. What do you consider major difficulties?
3. List examples to characterize difficulties with residents and in what processes / areas of training?
4. What are the technical and cognitive skills of teaching you feel more comfortable with?
5. What mentoring skills would you like to improve?
6. Please circle your methodological preferences (cases , seminars , lecture , films)

Other; _____

III -Graduating P (present) or N / A elements (not applicable) in the development of your topics / lessons and interdisciplinary relations within the residency:

Adequate time? ( )

Attention of the audience? ( )

Timing , adequate space , accommodation / comfort? ( )

Performance of resident physicians working with patients? ( )

Health care team relationships? ( )

Environment of trust / collegiality among teachers? ( )

Diversity of patients and care areas? Library, Internet? ( )

Residents evaluations of instructors? Objectives formulated by instructors for each teaching session? Constructive feedback to their residents? ( )

IV – Please, grade current status of medical residents regarding:

Level of friendliness
communication
depression
fatigue
Mood disorders
Loss of energy
Know asking for help
disciplined
organized
respectful
ethical
committed
trustful

Attributes	Poor	Average	Sufficient	Not applicable

V – Answer the following questions:

Do you seek information on the level of development of each resident /

technical training and interests BEFORE initiating any teaching session?

The teaching session begins with you asking questions? or statements?

You stimulate the potential apprentice to political / educational leadership and research

In the specialty?

Yes	No	Never

VI - Please list suggestions for increasing:

The level of trust and credibility of apprentices for their mentor:

The stimulus / collaboration of the other components of the anesthesia service in matters of vocational training.

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The Professional Well-being Of Anesthesiologists

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This article is based on and its many parts are copied from my doctor's dissertation: Lindfors P. Work-related well-being of Finnish anesthesiologists. People and work. Research reports 88, Finnish Institute of Occupational Health, Helsinki 2010.

1- Conceptual background of the professional well-being of anesthesiologists

Holistic and multidimensional view of well-being and health

The well-being of an individual can be understood as the net effect of positive and negative bio–psycho–socio–cultural factors. The human mind and body are in this context understood holistically without a dualistic division into psychological or physical. This understanding is supported by studies during the latest decade using brain imaging and electron microscopy that show that mental phenomena correlate with neuro-chemical changes and vice versa. However, for research reasons the variables are categorized as physical, mental, social, and cultural.

Health and related well-being can be defined in many ways. Some definitions are the following:

1. Health, according to the World Health Organization (WHO 1948), is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. This ideal state is, however, unrealistic to attain, and can only be aimed at.

2. Antonovsky (1979) introduced a "salutogenetic orientation" toward health, *sense of coherence* (SOC), according to which a person's health is determined to a great extent by how he or she experiences the world as meaningful, comprehensible, and manageable. This can be seen as a paradigm shift in health discourse from a disease-centered model of pathogenesis to a resource-oriented salutogenesis aimed at prevention (Bengel et al. 1999). SOC accords with the holistic view of health: It encourages an individual to strengthen the healthy aspects of his/her organism even when suffering symptoms of illness. It also emphasizes the importance of culture – especially morals, ethics and norms – for well-being and health: Acting against one's value system might affect one's health.

3. The statistical norm of health is determined by the frequency of a characteristic of the organism: deviations from average values are considered to indicate disease (Bengel et al. 1999).

4. Health can also be understood as a functional norm: the person's ability to fulfill his/her role in society (Erben et al. 1989). A purely Western medical perspective neglects important dimensions of the individual's condition, such as the ability to perform and work, and life satisfaction and well-being.

In this context, health is understood as a multidimensional concept including positive body feeling, absence of complaints or signs of disease; joy, happiness, job and life satisfaction, performance, self-realization and sense of meaningfulness. Health depends on the existence and on the perception of stress and strain and on the means of dealing with it (Bengel et al. 1999).

Load–stress–strain

The concept of `stress´ is complicated, with differing definitions. The first studies on stress were based on physiology, but since the 1950s different psychological models have emerged.

Stimulus-based approach

The word stress comes from the Latin word *stringere,* draw tight. Definitions of strain and load used in physics came to express how stress affects individuals. According to this model, external forces (load) are seen as exerting pressure upon an individual, producing strain (Arnold et al. 1995).

Response-based approach

A second concept defines stress as a person's response to a disturbance. Cannon (1930) studied the fight or flight reaction in animals and humans and observed that these subjects – in cold, lack of oxygen and excitement – excreted adrenalin. He described these individuals as being "under stress." Selye (1946) created the concept of stress: a situation where a person feels tense, anxious, nervous, restless, and has difficulties in sleeping since stressful things are so troublesome. He described a general adaptation syndrome (GAS) which describes three chronologic stages of response in a prolonged activation of *stressors*. As he describes them:

> *1. Alarm reaction*: lowered resistance followed by a counter-shock during which the defense mechanisms become active. *2. Resistance:* the stage of maximum adaptation and, hopefully, successful return to equilibrium for the individual. *3. Exhaustion*: when adaptive mechanisms collapse. Later, Selye (1974) separated the concept of distress from good stress (eustress): an appropriate amount of stress is needed for the well-being of the organism. During optimal stress, alertness and awareness improve as well as many life functions, and physiological mechanisms that increase the sensation of well-being become activated.

Interactional approach

Newer theories emphasize the interaction between a person and his or her environment. In Cummings and Cooper's (1979) *cybernetic* framework for occupational stress, the focus is on the stress cycle, "the sequential events that represent the continuous interaction between person and environment." According to this, individuals try to keep their thoughts, emotions, and relationships in a steady state. There is a range of stability (homeostasis) in which the individuals feel comfortable. When this stability is disrupted, the individual has to make adjustments or activate coping strategies in order to maintain or achieve the

stability again. Stress, according to them is any *force* that pushes a psychological or physical factor beyond its range of stability, producing a strain within the individual. In Caplan's *person and environment fit* model (1987) the focus is on the degree the employee's skills, needs, and expectations match the employer's requirements and provisions.

Transactional approach

In Lazarus's transactional approach, stress can be understood as a process: a mis–fit between an individual and his particular environment (Lazarus and Folkman 1984). Individuals, according to this theory, make a cognitive evaluation of threats that come from the environment. The degree to which people evaluate stress as a serious threat reveals the level of their perceived stress. In this model more emphasis is placed on individual differences than in the interactive models.

Most studies on work stress have considered the following factors in their theoretical framework: the presence of stressors, the evaluation process, and the response. However, there is still no consensus as to the definition of stress, nor as to the work stress process.

Allostasis and allostatic load

Adaptation in stressful situations involves activation of neuro–immuno–endocrinological mechanisms. This adaptation, according to Sterling and Eyer (1988), is called "allostasis", meaning that an organism has regained a new stability through change. Allostasis is essential in maintaining homeostasis. When these adaptive systems are turned on and off efficiently and not too frequently, the body is able to cope effectively with stressors that it might not otherwise manage. However, in excessively high and longstanding stressful situations causing strain, allostatic systems may become over-stimulated and fail to function normally. This disturbance in the allostasis system is called "allostatic load" or the price of adaptation (McEwen and Stellar 1993). Allostatic load leads to disturbances in the defense system of the organism, causing changes in neuro–immuno–endocrinological and pain pathways, which over time may lead to disease (McEwen 1998, 2002, 2007). However, the deleterious effects of chronic stress can be counteracted by supporting the strengths of the individual, allowing him/her to function according to his value system and positive expectations, increasing social support, promoting healthy behaviors (physical exercise, stretching, pause gymnastics, optimal nutrition, optimal sleep and rest, moderate drinking, no smoking…), optimizing ergonomics and reducing strain related to psycho–socio–cultural aspects at the workplace (Antonovsky 1979, Hyyppä et al. 1991, Marmot et al. 1997, Bengel et al. 1999, Elovainio et al. 2002, Kalimo et al. 2003a, Heponiemi et al. 2006, McEwen 2007, Lindfors et al. 2009b,c).

When modeling our stress process it is important to take into account the whole environment of the anesthesiologist including organization, patients, family, social life, life events and personal demands. (Lindfors P, 2010, p. 35. Figure 1)

Burnout

Burnout refers to a negative consequence of chronic work-related stress (Maslach et al. 2001). Theoretical models of burnout range from individual to interpersonal, organizational, and societal. Many share the assumption of a chronic discrepancy between expectations of a motivated employee and the reality of unfavorable work conditions. Development moves toward burnout via dysfunctional ways of coping (Schaufeli and Enzmann 1998). Studies have shown that neuroticism, alexithymia, fragility, and low sense of coherence are related to vulnerability to burnout (Schaufeli and Enzmann 1998, Kalimo et al. 2003a).

According to Maslach (1996), burnout is defined as a three-dimensional psychological syndrome including emotional exhaustion, cynicism, and reduced professional efficacy. It also encompasses the process of energy depletion at work instead of reducing burnout to a state of fatigue (Schaufeli and Taris 2005). High scores for exhaustion and cynicism and low scores for professional efficacy indicate burnout (Maslach 1996). Kalimo & colleagues (2003a) have further developed the MBI and formed a "Finnish burnout index" which makes it possible to assess the experience of burnout with one measure.

During the last decade the focus has been also on engagement, the positive antithesis of burnout, which has given new perspectives on interventions to alleviate burnout (Maslach et al. 2001, Hakanen J, 2009).

Working conditions

Working conditions can be characterized as physical and mental conditions relating to the work environment. They are known to be potential sources of stress, health hazards, and disease, but they may also enhance well-being, work ability, and job and life satisfaction. Furthermore, they can shape health behaviors (Stansfeld et al. 1998, Kouvonen et al. 2007, Heponiemi et al. 2008). However, individual differences – linked to gender, genetics, life environment, life events, learned models to deal with stress, and actual life situation – play a crucial role in the etiological chain between working conditions and well-being and health (Antonovsky 1979, Cummings and Cooper 1979, McEwen 2002, McEwen 2007). Moreover, individual factors can either make a person prone to strain or can protect him/her from it.

Physical workload

Physical conditions comprise one's workload such as demanding physical exercise and exposure to physical and chemical threats (Cox and Rial-González 2000). Physical workload may be connected to health via physical (nociceptive) or psychological stress-mediated pathways (Cox and Rial-González 2000, McEwen 2007). Physical workload is dependent on occupation (Hemström 2001) and has been mostly related to blue-collar work and low social class (Suadicani et al. 1995), but white-collar workers doing office work with computers experience a static and repetitive physical workload.

The anesthesiologist's work may consist of physical exertion – such as lifting heavy patients, repetitive motion, static muscle work, maintaining the same position without being able to move, difficult, awkward working positions, standing, walking – and exposure to cold, heat, humidity, dryness of the air, air conditioning, x-rays, magnetism, chemicals (cytostatics, cement for prostheses, gas, traces of narcotics in the air, formaldehyde), noise, bright light at night, infectious agents (TBC, influenza, HIV, hepatitis ...), wounds (needle stick), violence/aggression.

Mental workload

Mental workload can be understood as work-related psycho–socio–cultural factors affecting well-being and health. It constitutes an "umbrella concept" which includes organizational culture, roles in the organization, organizational justice, job control, workplace atmosphere, job security, and social support (Karasek 1979, Sherbourne and Stewart 1991, Elovainio et al. 2001, 2002, 2003, 2005).

In an anesthesiologist's profession, too-long working hours when on call, work without pauses, an excessive workload, too difficult procedures or clinical tasks, fear of harming patients, emotional demands when facing patients' pain, suffering, and death, an unfriendly workplace atmosphere, unclear tasks, lack of educational possibilities, dangerous or ergonomically poorly designed work environments, lack of professional control and decision- making possibilities, and ideological conflicts at the workplace may bring on harmful stress (Åkerstedt et al. 2002, van Amelsvoort et al. 2003, Shanafelt et al. 2003, Cole and Carlin 2009, Wallace et al. 2009). Stressors outside work can also weaken one's management of work-related stress.

Models of psycho–socio–cultural factors affecting health

Three models defining stressful psycho–social factors affecting health have been tested: the job strain model, the social support model, and the organizational justice model. "These models have all gained some empirical support for predicting health problems and can be regarded as complementary models concentrating on different aspects of the perceived work environment. The job strain model focuses on situational factors of work and arrangements, the social support model on the quality of cooperation and social interaction at work, and the organizational justice model on decision-making procedures and managerial practices" (Karasek 1979, 1990, Sarason et al. 1987, Theorell 1990, Elovainio et al. 2001, Kivimäki et al. 2003a, Lindfors et al. 2009c).

Job strain – Karasek's demand–control model

A discrepancy between demands and capacities, expectations, strengths, and needs can lead to harmful stress (Karasek 1979, Muntaner et al. 2006). Karasek created a model to study the effects of psycho–socio–cultural work stress on health outcomes (Karasek 1979). According to his demand–control model (DC), job strain is defined by the relationship between two independent inputs: job demands and control of the work situation. The former refers to psychological stress, such as having too

much or too demanding work or both, or time pressure, or interruptions. The latter involves employees' authority to make decisions concerning their actual jobs and the use of their skills regarding their task variety and options to develop and learn new things. High job strain, according to this model, results from situations with high job demands and low job control. Karasek defined these two factors as the most important determinants of work-related well-being and health (Karasek 1979). The DC-model focuses on the organization, not on the individual.

Demand–control–social support model

By refining the DC-model, Karasek and Theorell formulated a new model of work organization and its psychophysiological effects. According to this model, those who experience high social support are less at risk in a high-strain situation than are those who experience low social support (Theorell 1990, Karasek 1990).

This model has been criticized for its relevance to occupational homogeneity, for its stability over time, and for its conceptualization. Working with human beings, such as in the health profession, is different from and more complex than working with objects. Emotional demands (facing illness, pain, suffering) and conflicts between goals and reality are lacking from the concepts. The model has also been criticized for the interdependence of the two basic concepts: a worker with good decision authority over the work performed is able to diminish those demands, which do not fit the model. The job strain model became, however, more applicable to human service organizations when social support was added (Söderfeldt 1996).

Despite criticism, this model with its modification has been validated in numerous epidemiological studies (Bosma et al. 1998). Meta-analyses have indicated that Karasek's model is linked with poor health outcomes and an increase in coronary heart disease in particular, which is not explained by physical or chemical exposures at the workplace (Kivimäki et al. 2006). Whitehall II studies have shown that low job control is a mediator that links low socio-economic status to higher mortality through cardiovascular deaths (Marmot et al. 1997). A recent study suggests that the demand–control–support model predicts not only job strain, but also job satisfaction and organizational commitment (Rodwell et al. 2009).

Both individual and group level assessments are important when studying the associations between these psycho-social factors and health. Moreover, social relations outside work should also be taken into account when studying employee's perceptions of their work. Organizational norms governing work performance and social relations, and conflicts in the work-family interface have explained variance in job stress (Hammer 2004). The most deleterious combination is assumed to the conjunction of high job demands, low job control, and lack of social support from colleagues and supervisors, which is called isolated strain (Karasek 1990).

Approaches to social support

Social support has been defined in many ways. It can be understood as non-work-related support from family members, friends, and significant others, as well as work-related support form co-workers, colleagues, or chiefs when facing difficulties (Sarason et al. 1987). It might also mean opportunities to interact with others or to have someone present (Karasek 1990). The interaction may take place in the form of feedback, backup, and give one the sense of being able to control one's environment (Caplan 1974). It may, in addition, bring to an individual the awareness of his/her being a member of a social network, receiving love and respect (Cobb 1976). Various studies have shown that people with greater social support adjust better to life changes than do those with less support (Antonovsky 1974, Caplan 1974, Bell et al. 1982, Lindfors et al. 2009a, 2009b, 2009c). According to Hobfoll (1988), social support means relationships that give people real help and bind them to the social system that is believed to give love, care, and a sense of being attached to a respected social group or relationship. Brugha's (2005) studies suggested a minimum of four persons for the primary network of an individual to provide adequate support to allow well-being and health.

Social relationships enable a transfer of culture. The support of family and friends appears to be more effective than that of co-workers, colleagues, and chiefs in mitigating the effects of stress at work and outside work. According to one meta-analysis, social support has got three effects: to reduce the load, the stress, and the strain (Viswesvaran et al. 1999).

Organizational justice

The term organizational justice refers to the extent to which employees are treated in a just way at their workplace. It includes a procedural component (the extent to which decision-making procedures include input from the affected parties, are consistently applied, suppress bias, and are accurate, correctable, and ethical) and a relational component (polite, considerate, and fair treatment of individuals). It has been shown to be an important predictor of organizational attitudes, such as commitment and involvement, as well as of the feelings and behavior of employees (Cropanzano et al. 2001). Various studies support the link from low organizational justice to experienced strain, and further to sick leave and health problems (Elovainio et al. 2001, 2002, Kivimäki et al. 2003b, 2003c).

Organizational justice is sometimes suggested to represent a shared experience between employees in the same work unit. Some studies, however, show that it is individual perception that is essential for organizational justice to affect individual health (Cropanzano et al. 2001). Low-justice work environment, characterized by unjust organizational policies, practices, and procedures, is according to cross-sectional findings a greater risk to health than is unfair treatment from an immediate supervisor. A high sense of organizational justice appears to be linked to health, especially among highly educated people with demanding jobs, high status, and responsibility (Elovainio et al. 2002).

Approaches to organizational culture

Informal organization is essential for to successful funtioning of the formal organization (Barnard 1938). Definitions for culture and organization differ. Culture can be defined as the set of meanings, behavioral norms, values, and practices of members of a particular society as they construct their unique view of the world. As such, culture deeply informs every aspect of life and health. Effective interventions to restore and promote health may thus be enhanced through consideration of cultural contexts and configurations (Mezzich 2009).

In this chapter, the following concept for organizational culture was adopted: It means shared, learned ways of thinking and behavior among the members of the organization with the aim to develop individual and societal growth and adaptation. It is complex comprising knowledge, moral, norms, customs, meanings, and socially transmitted ways of behavior (Tylor 1871, Keesing 1981, Schein 1985). A member of the organization grows into the culture and becomes dependent on it. Each individual, creates and reinforces the culture (Tylor 1871, Keesing 1981). Codes of conduct in the workplace ensure commitment, identity, coherence, and a sense of community (Barnard 1938).

According to Louis (1980): "The unspoken in an organization is more powerful than the spoken." One gradually starts to sense the feeling of a workplace, and the way of working. Organizational culture may also be considered as the character of an organization, its climate, ideology and image.

The origins of the concept of organizational culture are in anthropology. The focus of its research has been since the 1990s on the uniquely integrative and phenomenological core of the subject, in which the interweaving of individuals into a workplace community takes place, and in the notions of meaning, emergence, and function (Louis 1980). The research in the field has been carried on from semiotic, cognitive and interactional perspectives. According to Smircich (1985), culture can serve as a paradigm for understanding organizations and ourselves. "Culture is constantly in dynamic fusion and should not be reduced to one more variable in a static model of life at work". Cultural research contributes to understanding, to improvement or potentiation – and answering the questions: What should be the role of work? How might individuals contribute and receive …? How should efforts be organized?

Framework for the Professional Well-being of Anesthesiologists

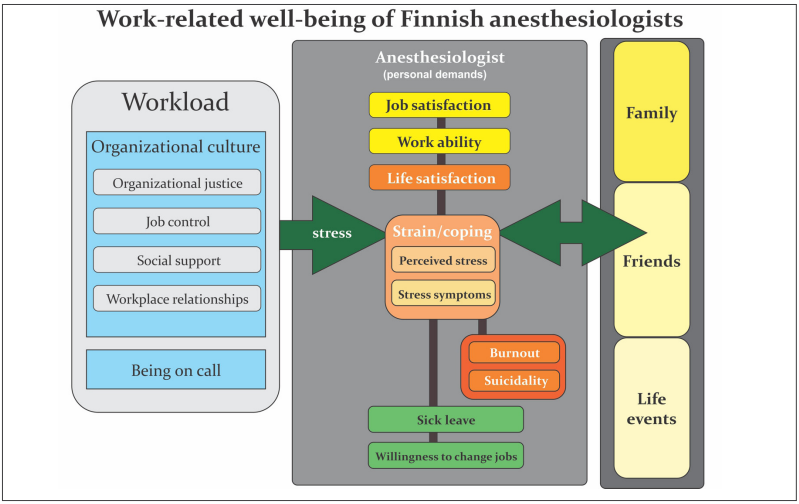
Working conditions in the framework are approached from the perspective of perceived physical and mental workload related to on-call duty and sleep deprivation and psycho–socio–cultural factors –workplace atmosphere, job control, organizational justice, social support, and the work–home interface– and their connection with job strain.

The concepts of load, stress, and strain are adopted combining these theories: The focus is on the strain that the anesthesiologist feels when the workload creates stress on him/her. Life satisfaction, job satisfaction, work ability, job turnover, and sickness

absence are outcomes of strain *vs* coping with strain reflecting the mismacth/ macth between the individual and the particular environment. Organizational culture – including organizational injustice, low job control, lack of social support at work, and unfriendly workplace atmosphere – and being on call are hypothesized to be the biggest stressors or loading factors at work. Stress can be seen, on the one hand, as the force that arises when the workload directs at the anesthesiologist, causing strain. On the other hand, the "load" causing strain via stress can be intrinsic, related to the personal demands the anesthesiologist has put upon him-/herself. However, the "intrinsic load" is not shown in the framework as such. The strain is expressed as perceived stress and stress symptoms. If the strain is too high or longstanding or both, coping mechanisms fail, and the anesthesiologist ends up with an allostatic load. Burnout and suicidality are outcomes of allostatic load.

Family (its consistency, stability, interaction style), friends (their number, quality, and proximity), and life events (protective and traumatic) can be seen as personal and family-related factors that interact with the strain *vs* coping. The framework can be seen in **Figure 1.**

Figure 1. Framework of the study: work-related well-being of anesthesiologists.



Presentation of problems in the professional well-being of anesthesiologists

A short review of problems among anesthesiologists

Physicians are known to live longer than does the general population (Töyry 2005), but anesthesiologists appear to be an exception, since according to international studies, they often *die at an earlier age* than their colleagues (Wright and Roberts 1996, Khaw 1997, Svärdsudd et al. 2002). The *stress levels* they experience are *at a higher range*, together with surgeons, when compared with other physicians (Payne and Rick 1986, Cooper et al. 1999, Jackson 1999, Lindfors et al. 2006, Nyssen and

Hansez 2008, Lindfors 2010). Anesthesiologists, however, suffer from even higher momentary stress than surgeons (Payne and Rick 1986), have *a high on-call burden*, and will often need to continue on an on-call rota until retirement, unlike most other specialists (Saunders 2006, Lindfors et al. 2006). Being on call can be stressful for many reasons: sleep deprivation, time constraints, lack of possibilities for consultation, fear of harming patients, responsibility for unpredictable emergency cases, and an unfamiliar work environment (Lindfors et al. 2006, Malmberg et al. 2007, Gander et al. 2008). Especially when on call, the anesthesiologist serves as a gatekeeper to keep the patient alive until other specialists can take over. The anesthesiologist will need to make quick decisions and do skillful, but risky procedures.

Sleep deprivation alone has been linked to higher accident risk, serious illness symptoms, morbidity from stress-related diseases and even death at an earlier age from cancer or cardiovascular problems (Meier-Ewert et al. 2004, Dembe et al. 2005, Dinges et al. 2005, Megdal et al. 2005, Van Cauter 2005, Lindfors et al. 2006). Most probably the other causes of on-call stress add to the negative health effects of sleep deprivation.

Until recently, anesthesiologists have worked as surgeons' assistants and have had limited control over their everyday work. *Organizational problems* including structural changes with fusions, layoffs, the break-up of teams, changes in the work unit, faceless leaders, and business thinking, together with economic crises, may further increase the on-call burden and stress on the anesthesiologist (Kalimo et al. 2003b, Vahtera et al. 2004, Lindfors et al. 2006, 2007, 2009a,b,c). Since more women than before are working as anesthesiologists nowadays in Finland, *combining work and being on call with family life* has become an even more important issue (Lindfors et al. 2006, 2007, Lindfors 2010).

Suicide has been more frequent among physicians than among other professionals and the general population (Lindeman 1997, Schernhammer and Colditz 2004, Wallace et al. 2009). Among physicians, anesthesiologists appear to be one of the *highest in suicide risk* (Lew 1979, Seeley 1996, Hem et al. 2000, Alexander et al. 2000, Hawton et al. 2001, Ohtonen 2002, Schernhammer 2005, Lindfors et al. 2009b). Anesthesiologists are known to have a higher rate of substance–use disorders – especially of opioids – than do that of other physicians (McAuliffe et al. 2006, Skipper et al. 2009). *Alcohol* (Lindfors et al. 2009b) *and drug abuse* (Baird et Morgan 2000, Gold et al. 2005) are connected to suicidality or suicides among anethesiologists.

Knowledge of anesthesiologists' work-related well-being is sparse and contradictory: According to some studies, anesthesiologists have higher stress levels than do other physicians (Dickson 1996; Lindfors et al. 2006), and the reasons for their stress are related to organization and being on call (Cooper 1999, Lindfors et al. 2006). However, other studies have shown that their burnout levels are lower than those of other physicians, and their job satisfaction is quite good (Kluger et al. 2003, Lindfors et al. 2006).

These facts challenge us to study further the well-being of anesthesiologists as an example of a medical specialty experiencing high work strain in order to improve the well-being of all physicians.

Main findings in the well-being study among anesthesiologists

To my knowledge studies based on my dissertation on the work-related well-being of Finnish anesthesiologists (Lindfors 2010) is the most comprehensible effort to try to understand the problems in our well-being. This is why I have concluded our main findings here.

Our work stress derives from high workload and being on call, and from work atmosphere and organizational problems. Being on call might be dangerous.

Work-related stress and exhaustion are common among anesthesiologists (Lindfors et al. 2006, De Oliveira et al. 2011, Rama-Maceiras et al. 2012, Lindfors 2012). The most important causes of stress are work and combining work with family life. The biggest worries at work are general workload and time constraints, the work atmosphere and organizational problems, and fear of harming patients. Being on call is one of the most important causes of our stress; anesthesiologists often have the greatest on-call burden among physicians. Unlike other specialists we often continue to have an on-call commitment until the age of retirement. On-call duty is the greatest reason for our perceived sleep deprivation. Being on call is significantly correlated with various stress symptoms such as nausea, coordination disturbances, exhaustion, dizziness, difficulties in understanding speech, and tremor. These symptoms are associated with take-up of sick leave. Women seem to be more affected by stress than are men. High job control and organizational justice may mitigate the effect of hospital on-call strain on the number of stress symptoms (Lindfors et al. 2009c).

Job satisfaction depends on organizational culture and workplace atmosphere.

Anesthesiologists - even though highly stressed - enjoy moderate or fairly high job satisfaction, work ability, and life satisfaction (Lindfors et al. 2007, Lindfors 2010). Job control, organizational justice and workplace atmosphere are the most important variables in the work-related well-being of the anesthesiologists (Lindfors 2010, Rama-Maceiras and Kranke 2013). Female anesthesiologists are in a less advantageous work and work/family situation (job contract, job control, domestic work burden) than are their male colleagues. However, no gender differences seem to appear in levels of job satisfaction, work ability, or life satisfaction, although work-related factors are slightly more important determinants of those well-being indicators in males, and family-related in female anesthesiologists (Lindfors et al. 2007). Older employees appear to be more satisfied than younger ones (Hagopian et al. 2009). Clinical work seems to cause the least stress (Kluger et al. 2003). Moreover, the meaningfulness of being able to help patients, to receive immediate feedback, and the respect shown to the physician's profession seem to buffer

against work-related stress (Kluger et al. 2003, Van Ham et al. 2006). Job satisfaction is crucial in maintaining physician's health (Williams and Skinner 2003, Faragher et al. 2005).

Low social support is the main connection to our high suicidality.

A quarter of the anesthesiologists have considered suicide. Work-related factors associated with suicidality are conflicts with co-workers and superiors, lack of justice at the workplace, and being on call. Family-related and personal factors are poor health, low social support, family problems, traumatic life events, lack of friends, alcohol abuse, and smoking. Family-related and personal factors seem to be more relevant risks than work-related factors. Accumulation of risk factors increase prominently the risk for suicidality. (Lindfors et al. 2009b).

In conclusion

Job strain among anesthesiologists is high when measured by a variety of indicators, such as stress level, on-call burden, stress symptoms, burnout, sick leave, sleep deprivation, suicidality, and low job commitment. However, the anesthesiologists enjoy fairly good job satisfaction, work ability, and life satisfaction. This may depend in their good coping mechanisms in stressful situations.

The most important work-related factors associated with well-being are on-call burden, job control, organizational justice, and social relations at work. The work situation of female *vs* male anesthesiologists is disadvantageous. Among female anesthesiologists, factors outside work are more important than in men.

On-call work-burden, job control, and fairness of decision-making procedures, and interpersonal relationships should be the focus in aiming to increase work-related well-being of anesthesiologists.

Today's challenges in the medical profession: dehumanization of medicine

Since our studies pointed out the importance of the medical culture in the well-being of anesthesiologists I would like to bring a delicate subject into discussion: the dehumanization of the medical culture.

Lately, a continuing discussion has been taking place in the medical community: During recent decades together with the development of modern medicine, the physician's work has become more dehumanized. New technologies and organizational, changes together with increased accountability have altered the doctor–patient relationship. Subspecialized physicians know more about less. Doctors treat diseases, ignoring illness. Evidence-based medicine often does not take into account the individual suffering of the patient. Medical schools teach science but ignore the art of medicine and moral understanding. Bureaucracy takes over a large part of the research, and competition for research funding increases. Health care systems are often unjust and broken. Many hospitals have become huge, cold "marketplaces"

where fewer personnel must take care of more patients (Edwards et al. 2002, Shanafelt et al. 2003, Cole and Carlin 2009, Wallace et al. 2009). Physicians also confront increasing regulations, malpractice suits, and an expanding knowledge base (Shanafelt et al. 2003). Furthermore, physicians, especially anesthesiologists, work in emotionally charged situations associated with suffering, fear, failure, and death, which may culminate in difficult interactions with patients, families, and medical staff (Wallace et al. 2009).

Moreover, academic medicine has been accused of being inattentive to humanistic values, which has caused retention problems in the medical faculties (Lieff 2009). Professional development has been claimed to lack meaning, purpose, and professional fulfillment, and possibilities to reflect on these issues.

According to Cole and Carlin (2009): "Medicine is filled with many people of good will, integrity, and commitment who strive to provide compassionate and ethically sound care, teach and mentor students, maintain scientific standards of practice, keep current with the most recent literature in one's field and undertake biomedical research." Yet current conditions prevent physicians from living up to their requirements and ideals. This conflict is born when organizations ignore existing working conditions and rigidly enforce moral rules, doing ethical violence (Cole and Carlin 2009). "This may cause a cognitive dissonance among physicians, leading to disillusionment, self-doubt, dis-ease, and retreat from ideals."

The contradictory fact that many physicians have lost sight of their own well-being – and think that illness has nothing to do with them – might worsen their situation. They work when ill and expect their colleagues to do the same. Moreover, with altruistic intent, physicians often place professional responsibilities above personal ones (Shanafelt et al. 2003, Wallace et al. 2009). This kind of behavior has been connected to certain personality traits, such as perfectionism, neuroticism, work holism, conscientiousness, ambitiousness (Schernhammer and Colditz 2004, Tyssen et al. 2007, Wallace et al. 2009). The effect of professional and personal factors on physicians' wellness is exacerbated by the tendency of many physicians to protect the privacy of their impaired colleagues (Wallace et al. 2009).Wallace & colleagues (2009) conclude in their review: "The culture of the medical profession has been recognized as a key factor that might deter doctors from taking care of themselves."

Against this backdrop, it is not surprising that physicians are unwell: rates of stress, burnout, anxiety, depression, and suicide have been reported to be higher than among the general population (Schernhammer and Colditz 2004, Cole and Carlin 2009, Wallace et al. 2009). Moreover, impared physicians have also been shown to pose risks for patient care and negatively affect health care systems (Wallace et al. 2009).

These dehumanizing trends are evident worldwide especially in the western medical culture and affect as well the well-being of anesthesiologists whose job is more technical and less human than that of other physicians.

Recommendations for improvement of the professional well-being of anesthesiologists

Organizational interventions

In order to reduce the occupational stress of the anesthesiologists on an organizational level interventions are needed to limit the on-call work burden, improve organizational culture – especially workplace atmosphere, organizational justice and job control – and make it possible to combine work with family and social life.

On-call burden may be best reduced by limiting the number of shifts and shortening the on-call work period. Work arrangements such as limiting the night work only to emergencies and improving consultation possibilities could also reduce on-call-related stress. Liberation of the senior anesthesiologists after a certain age limit (50 years) and those with serious health problems, from any on-call-duty obligation would be recommendable.

Conflicts at the workplace can be reduced by various measures to establish trust, mutual commitment, effective communication, and building of individual relationships. Offering social support, showing respect and gratitude, being flexible, and maximizing the use of each individual's capacities and actual strengths might help in reaching those targets.

In order to increase anesthesiologists' job control they should receive a possibility to affect the changes made in daily tasks at work, order of the tasks, use of time, pace of work, working methods, division of tasks, decisions regarding co-workers, and the tools and machines worked with. All tasks need proper descriptions. The amount of work and hours of working should be limited in relation to human endurance. Individual need for rest should be respected and sufficient support organized. Predictability of the tasks should be maximimal and interruptions minimized.

The anesthesiologist's experience of organizational justice can be maximized if it is clear that decisions are made based on accurate information, incorrect decisions can be changed, everyone can express an opinion concerning decision-making related to the work, decisions made are consistent, effects of the decisions are investigated, information on the effects delivered, and additional information on the grounds of the decisions is available.

Opportunities for a flexible integration of work with family life and for allowing time for personal life and recovery from work-related stress are also essential to ensure anesthesiologists' high life satisfaction. This requires promotion of a more flexible working culture and part-time options. What deserves attention is the enhancement of the disadvantageous situation of female *vs* male anesthesiologists regarding job control, permanent job contracts, domestic workload and related strain.

Emphasis should be placed upon improving superiors' leadeship skills. Conversations, mentoring, and external counseling – with the support of an occupational health care system – should form a natural part of workplace problem solving.

Regular annual assessment of job and life satisfaction, as well as of stress levels and perceived health and their connection with relationships between superiors and colleagues, and one's involvement with organizational decision-making and career development is necessary at the workplace in coordination with the occupational health care system. Employers could become more motivated in organizing these assessments and possible interventions, if their focus was on physician wellness as a quality indicator of the health care system (Wallace et al. 2009).

Occupational health care and professional interventions

The physicians' health care system needs to be organized so that it is of high level, confidental, and available for all physicians regardless of the workplace, working time, job contract, or the position. A pre-employment health check-up by an occupational physician and periodic health examinations (every 5 years) with increasing frequency with advancing age (every 3 years) should be organized for all physicians, but especially for the anesthesiologists, because of their highly stressful job. It would be of utmost importance for health care professionals to recognize suicidal physicians. A screening health questionnaire including suicidality together with known risk factors including those reported in this study could be used at all occupational health check-ups and when needed during other visits to the occupational physician. Focus should be upon any accumulation of risk factors. Work-place risk assessments should not concentrate only on chemical exposures or ergonomic problems. Much more emphasis is needed on the mental burden linked to conflicts at the workplace and problems in the organizational culture.

Occupational health practices development could involve a project in coordination with the workplace safety organization in order to sensitize physicians both on an organizational and individual level to notice, face, discuss, and help solve health problems of themselves or of colleagues. Story-telling or Balint groups could foster awareness of and reflection on problems related to workplace atmosphere, patient care, or one's own health.

Psychological testing before entering medical school could be considered for screening students suitable for the stressful medical profession or in need of therapeutic interventions. This could be repeated during the last year of medical school to help graduating physicians in choosing their future specialties. Courses in philosophy and psychology to enhance self-awareness and to maintain one's integrity, team work skills education, and stress management should be considered obligatory for medical students, along with refresher courses for specialist physicians.

Personal interventions

Appropriate therapy – including cognitive behavioural and relaxation techniques – should, when necessary, be organized for each individual with neither fear of job loss nor of breaching patient confidentiality. Strengthening bonds – marital, and with family and friends – needs emphasis. Physicians' therapies have been shown to be more successful than those of the general population (Wallace et al. 2009).

Successful organizational, professional, and personal interventions may dramatically enhance the health and well-being of anesthesiologists and reduce their stress levels, depression and intentions to commit suicide.

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- Part 2 -
Institutional responsibility for physician (anesthesiologist) occupational well-being

Correlation Between Anesthesiologists' Occupational Well-being and Surgical Patient Safety

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Introduction

The correlation between anesthesiologists' occupational health and the incidence of critical adverse events in clinical anesthesiology has been well evidenced in the literature. In this area of medicine, occupational fatigue is one of the main factors accountable for the high prevalence of crises[1-5].

A large number of publications indicate that excessive workload among physicians (average working hours, including shifts), including anesthesiologists, results in high levels of fatigue and a marked decrease in productivity and professional performance. These characteristics contribute to an evident increase in the incidence of critical events, medical malpractice included, in surgical patients, compromising their safety.

It should be acknowledged that multiple factors contribute to the establishment of occupational fatigue, as well as its consequences: burnout syndrome, chemical dependency, mental depression, suicidal ideation and others.

This chapter aims to discuss the responsibility of medical institutions that control the quality of medical training and clinical practice in attempting to also control the etiological factors of pathological conditions that alter the occupational health of anesthesiologists, thus enhancing patient safety.

Table 1 – Basic concepts on occupational well-being on medicine. Classes of recommendation and Levels of evidence.

Classes of Recommendation	
I	Consensus and evidence favoring indication
IIa	Divergence exists, but the majority favors indication
IIb	Divergence and division of opinions
III	Not recommended
Levels of Evidences	
A	Multiple controlled and randomized clinical trials
B	Single controlled and randomized clinical trial, non-randomized clinical trials, well-designed observational studies
C	Case series or case reports
D	Expert consensus

All the items that comprise the bibliography of this chapter are rated level of evidence A and B according to the classification of the Oxford Centre for Evidence-Based Medicine. Figure 1

"The secret of health for both mind and body is not to mourn for the past, worry about the future, or anticipate troubles, but to live in the present moment wisely and earnestly"

Buddha

Although Occupational well-being is a difficult topic to address, in 2005, the World Health Organization (WHO) defined it as[6]: "An individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns."

This perception can be altered by a complex range of situations, including the physical or mental state of professionals, their personal beliefs and socio-professional approach to significant events in their lives, including the work-place environment.

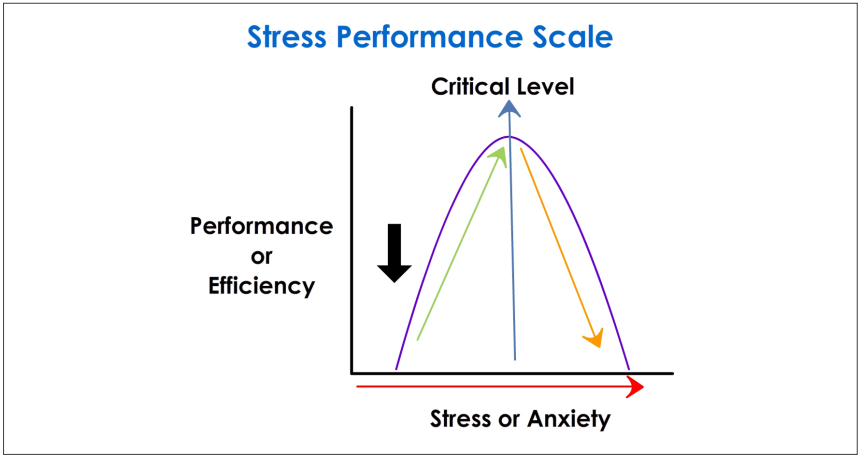
These theoretical concepts raise a question of practical importance: How do I feel mentally and physically each moment of every day regarding my professional activity, my relationships and my workplace environment?

When faced with this question, one should ponder whether he is merely facing difficulties and frustrations in the management of common stressful situations or whether he has progressed into a depressive syndrome as a result of biased interpretation of professional situations as exceptionally stressful (the capacity for perception of occupational stress varies widely between individuals).

Professor Hugo Hans Selye studied individual adaptability and described stress as the insidious destruction that results from cumulative depletion of internal resources. Thus, it is essential to understand that each individual has their own threshold of internal capacitance for coping healthily with stress and that, since this ability varies among individuals, it is not liable to interpersonal comparisons. Therefore, the establishment of conduct guidelines in relation to clinical activity must respect professionals' singularity[6].

Anesthesiologists are often attracted to the specialty due to the satisfaction derived from short but intense contact with patients, the development of manual technical skills, knowledge and handling of increasingly technologic equipment, the contact between different specialties and the ability to see immediate results of interventions. On the other hand, often the price to be paid upon entering this professional reality is recurrent loss of control, which for some people means the transition from positive stress to a pathological condition described as psychogenic distress (see **Figure 1**). Distress or negative stress is the excessive stress that occurs when one goes beyond personal limits and depletes his adaptive resources.

Figure 1 - Correlation between stress/occupational anxiety and performance/ professional efficiency



Occupational well-being of a healthcare professional is one's personal understanding on positive or negative factors that he or she is subjected to during routine clinical practice.

The human body and the psyche should be viewed holistically, without dichotomic divisions. This concept is supported by neuroimaging and electron microscopy studies that prove that mental phenomena are closely associated with neurochemical changes and vice versa.

Anesthesiology is a specialty considered to have prompted major advances in surgical patient safety over the last decades. There has been significant improvement in rates of morbidity and mortality due to innovations in monitoring and great progress in the understanding of pharmacology applied to clinical practice. However, in spite of scientific and technological evolution, patient harm continues to exist as a result of critical adverse events caused by anesthesiologists (medical malpractice).

One of the main causes of medical malpractice, well documented in the medical literature, is the level of occupational stress and its consequences on staff (fatigue, burnout, addiction, mental depression, etc..). This situation often develops in an insidious, cumulative fashion[7,8].

The growing demand of psychological pressure at work, associated with personal and social commitments, can be a heavy burden to carry, often resulting in occupational fatigue syndrome or disruption of occupational well-being in clinical anesthesiologists.

Occupational Fatigue (also known as exhaustion, tiredness, lethargy, fatigue, apathy, prostration and lassitude) can be differentiated based on predominance of its effects on the physical or psychological level.

Physical fatigue can be defined as the inability to maintain full operation of one's technical and scientific skills and usually becomes clearly visible during intense clinical practice, ranging from a general state of lethargy to a specific sensation of great physical exhaustion[3].

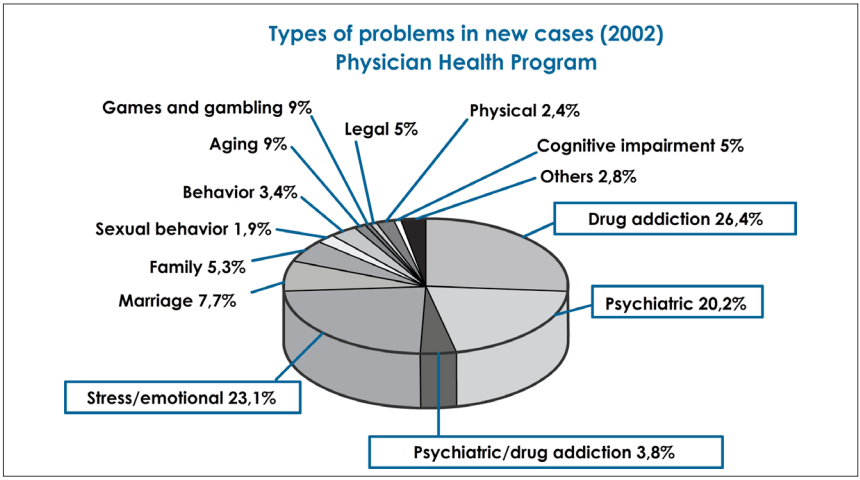
On the other hand, mental fatigue (cognitive dysfunction) is seen as the main causative agent of medical malpractice and critical incidents among anesthesiologists. It manifests as drowsiness, loss of concentration and, consequently, inability to perform accurate clinical assessments and impaired decision-making when facing emergencies. At present, this is the psychological condition that most directly impacts the performance of anesthesiologists, placing the safety of surgical patients at risk[9].

For decades, the work of the anesthesiologist has been described as "hours of boredom interspersed with moments of terror". The key question is what measures can be taken to prevent tedious hours from interfering with physician performance when the moments of terror occur.

Careful analysis of information regarding physician occupational health, particularly among anesthesiologists, leads to the very disturbing conclusion that effective institutional support systems for occupational diseases are almost non-existent in the world (see the survey of the Professional Well-being Committee of the World Federation of Societies of Anesthesiology).

Important information about support systems to physician occupational health is provided through a Canadian organization called Physician Health Program (OMA Ontario Medical Association). **Figure 2** shows statistics from this center, demonstrating significant disparity between somatic and psychiatric pathologies and highlighting the clear prevalence of psychiatric disorders in relation to somatic ones[10].

Figure 2 - Case series of the Support to Canadian Physicians' Health Program



In Brazil, a research institute for the treatment of addicted physicians (UNIAD) from the University of São Paulo, presented a case series, shown in **Table I**, including 57 anesthesiologists with clinical evidence of drug addiction treated in that department. (Internal hospital information data)

Table II demonstrates the frequency of psychiatric comorbidity among anesthesiologist addicts treated in UNIAD. As noted earlier, there is an obvious correlation between psychogenic pathologies developed while practicing anesthesiology and the establishment of chemical dependence.

Table II – Prevalence of comorbities in drug addicts from Uniad (São Paulo)

Diagnosis of psychological diseases (CID 10)		
	n	**%**
Total number of cases with morbidities	24	42,1
Depression (F32 e F33)	12	21,0
Personality disturbances (F60)	6	10,5
Bipolar disturbances (F31)	5	8,7
Anxiety disturbances (F41)	4	7,0
Schizophrenia (F20)	1	1,7

The agents most often used by this group of patients were opioids (53%), benzodiazepines (30%) and alcohol (23%). Chemical dependence in anesthesiologists shows a strong prevalence of opioids in relation to other drugs. Easy access to these drugs in operating suites, recovery rooms and post-operative care units (**Table III**) increases significantly the difficulty in providing psychiatric support, treatment and effective rehabilitation to specialists in anesthesiology. The risks are high for relapse and death by suicide or overdose (altered genetic coding).

Table III – Case series from Center for Treatment of Physicians Uniad – Unifesp (São Paulo)

Most used drugs			
Drugs	**Total**	**Alarming Use n (%)**	**Addiction n (%)**
Alcohol	20 (35,1)	7 (12,3)	12 (22,8)
Benzodiazepines	20 (35,1)	3 (5,2)	17 (29,8)
Opioids	34 (59,6)	4 (7,0)	30 (52,6)
Cocaine and crack	3 (5,2)	3 (5,2)	0 (0)
Marijuana	6 (10,5)	4 (7,0)	2 (3,5)
Amphetamines	6 (10,5)	2 (3,5)	4 (7,0)
Inhalational drugs	1 (1,8)	1 (1,8)	0 (0)

Summary - At present, concerns about occupational well-being of anesthesiologists as well as the prevalence of its disruptions and their consequences (fatigue, stress, mental depression, addiction, suicidal ideation and others) are well established in

the literature. This indicates the need for awareness and institutional actions aimed at addressing the problem in its multiple aspects.

Current Status of Occupational Well-being in Medical Education (medical students and residents) and in the practice of Anesthesiology

Occupational well-being is a direct reflection of the professional's psychic satisfaction in the workplace, the lack of which interferes markedly with the anesthesiologist's quality of life and endangers his health as well as patient safety. Certainly, integrating working conditions with physician quality of life in order to provide mental balance and personal satisfaction will lead to higher levels of occupational well-being.

Occupational well-being disturbances have significant prevalence in medicine, starting as early as in medical school.

During basic training, residents in anesthesiology as well as their supervisors should be alerted by the institutions responsible for medical training (Medical Schools and Centers of Clinical Learning and Training) about the risks for and consequences of pathologic disruptions of occupational well-being. Those include alterations in clinical performance, increased risks for patients under their responsibility and risk of death due to chemical dependency. Increasing awareness and creating structured support systems are extremely valuable, especially for interns, residents and their mentors under increased risk of developing addiction, such as those with high levels of stress and depression.

The study of occupational fatigue in physicians who work in clinical or experimental environments is highly complex due to its multifactorial nature, variation over time in psychologically different people and overlapping with associated conditions, such as high level of occupational stress, burnout syndrome, addiction and suicidal ideation. However, the study of occupational fatigue and the best means of controlling it is of critical importance for the maintenance of anesthesiologists' occupational health and patient safety.

Doctors are trained to focus exclusively on the patient in their clinical practice, to such a great degree they often ignore their own health and state of occupational well-being. However, it should be emphasized that physician health has a direct impact on patient safety, therefore institutions should also turn their attentions to healthcare providers' well-being. That kind of attention should be specifically highlighted concerning occupational fatigue of the anesthesiologist and its consequences, in order to prevent this often latent threat from progressing into damage to the patient[11].

The medical literature has shown a significantly higher prevalence of pathological disturbances of occupational well-being, such as burnout syndrome, in doctors and nurses when compared with the general population in the U.S. Doctors who perform their activity on the front line of medical care (Intensive Care Unit and Emergency Room) are more predisposed to these complications[12].

In recent decades, the work performed by anesthesiologists has changed dramatically in nature and intensity. The advent of new technologies has expanded the surgical horizon and allowed surgical interventions to be performed in patients with more challenging medical conditions. These facts, coupled with the surfacing of more difficult cases, of increasing emotional pressure, constant economic competitiveness and the need to do "more" with "reduced" workforce significantly raise the incidence of occupational stress and distress and all their consequences in the clinical practice of anesthesiology.

Current epidemiologic studies on physician occupational health focus mainly on investigating the prevalence of somatic and/or psychological pathologies, such as degenerative, cardiovascular, infectious and toxic diseases, fatigue and exhaustion, mental depression and addiction[13,14]. On the other hand, it is evident how little has been done regarding the prevention of these health issues and the ongoing maintenance of the occupational well-being of physicians.

As commented earlier in the text, occupational diseases have an early onset in the professional lives of physicians, chiefly in basic medical education, i.e., medical school.

A systematic analysis of articles on the incidence of depression, anxiety and burnout syndrome among medical students in the U.S. and Canada reached the conclusion that medical school is a period of intense occupational stress in one's life, often leading to pathological conditions as psychogenic distress. Unfortunately, current scientific knowledge is insufficient in methodological quality and number to establish the causative factors and the institutional courses of action to be taken regarding this issue. Therefore, it is necessary to develop epidemiological studies, especially multicenter prospective cohort studies with adequate statistical power to identify independent predictors, either individual or related to medical training, which contribute to the development of depressive, anxiety and burnout syndromes among medical students. Subsequently, the relationship between situations of psychogenic distress and university training regimen can be investigated in depth (e.g. revision of the curriculum of medicine and medical residency programs). Surely this is a matter of institutional responsibility for the quality of basic medical training and there is a pressing need for policies to establish diagnoses and implement support mechanisms for trainee doctors[15].

Psychological distress is quite prevalent among medical students, so curriculum organization and intrinsic requirements for the evaluation of progress within university structures can be extremely important in altering the state of occupational health in this group of novices.

A recent study evaluated the relationship between curricular structure and level of demands in different universities and their repercussions in the occupational well-being of medical students. This survey included academics from 12 medical schools

in the U.S. using the questionnaires *Perceived Stress Scale (PSS), Maslach Burnout Inventory (MBI)* and *Medical Outcome Study Short Form (SF-8)* as well as *Quality of Life (QQL)* for the evaluation of occupational stress, burnout syndrome and quality of life, respectively. The conclusion was that:

- The methodology by which students' progress is evaluated during graduation has greater impact on their occupational health than the specific curricular structure adopted by the institution;
- Curricular structure reformations should value ways and levels of approval and denial of the progression of students, underscoring institutional responsibility for the occupational health of this group[16].

A recently published cohort study highlighted that burnout syndrome, so obviously prevalent in residents and physicians, often has its origin during the graduation course of medicine. This study involved the evaluation of medical students (n = 1098) enrolled in the third year of a medical school in Minnesota, U.S. for the level of quality of life and the presence of symptoms suggestive of burnout syndrome, depression and alcohol abuse.

The results evidenced that, from a total of 545 respondents, 45% had symptoms of alcohol abuse, which showed close correlation with the level of progress of students. Low levels of quality of life had significant correlation with the incidence of burnout ($p < 0.03$ in multivariate analysis). The conclusion of this survey is that burnout syndrome is common among medical students in the U.S. and becomes more prominent as students progress through the course. Despite the notion that this syndrome is linked primarily to the level of occupational stress, the influence of prior experiences of respondents showed close correlation with the development of this syndrome during basic medical training, medical residency and medical practice after residency. The authors suggest that both personal and educational factors are closely related to the incidence of this syndrome and that every approach to it must consider both types of elements[17].

Residency programs provide a wide range of bonuses, although doctors in training are constantly faced with severe and terminal illnesses, suffering and death of their patients. Thus, an editorial entitled **"Who is ill: patients or residents?"** was published suggesting that the occupational health of residents may be severely compromised. There is an increasing number of studies in medical literature that identify that residency programs can disrupt the state of physician occupational well-being and that it may even have already been disrupted during basic medical training. Altering this reality is a responsibility of institutional bodies for the regulation of basic medical training and clinical practice[18].

Collins et al. analyzed American anesthesiology residents for a period of 10 years and concluded that 70% of residents suffering from drug addiction could return to medicine after a successful rehabilitation program. However, only 60% of those who

returned to medicine could successfully resume their training in anesthesiology and 9% died prematurely (overdose, suicide?). The authors concluded that anesthesiology trainees that develop addiction during the residency may be better off choosing a different medical specialty with lower risk for psychogenic disorders[19].

A study investigating the routine practice of extra-curricular activities (physical exercise, non-medical cultural activities and others) developed by the residents as compared with those developed by medical students and/or doctors after residency, shows that the first group perform significantly lower levels of these activities than the other two. This may be one of the factors that contribute to the establishment of psychopathological syndromes as burnout during the medical residency[20].

Literature shows a consistent increase in the prevalence of burnout syndrome (diagnosed with the Maslach Questionnaire) during residency programs in various specialties, amounting to 76% in Internal Medicine programs, 90% in Obstetrics-Gynecology, 74% in Pediatrics, and 27% in Otolaryngology and Family Medicine. Furthermore, the incidence is significantly higher among trainee doctors than their supervisors[21].

The abovementioned situation is no different in Anesthesiology: a study developed in Belgium addressed the incidence of burnout syndrome in anesthesiology residents and faculty supervisors (n = 318) and showed high prevalence of this syndrome, mainly in young residents. 40.4% of the study subjects showed moderate to severe levels of the syndrome. (**Table IV**)[22]

Table IV – Levels of burnout according to age ranges of anesthesiologists *

Levels of Burnout			
Ages	Low	Moderate	High
<30	4	34	24
30-35	8	21	12
35	11	12	15

* Br J Anaesth, 2003;90(3):333-373

Medical literature suggests the existence of a significant number of predictors for the establishment of syndromes secondary to disruptions in the occupational well-being of young anesthesiologists. Some of them are the number of working hours, the level of occupational stress in the workplace, negative signs of personality as intense pessimism, loss of self-confidence, lack of social and technical support and symptoms of burnout. In addition, other factors such as unstable and disorganized personality profile and the absence of regular performance assessment (*feedback*) contribute to the onset of psychiatric syndromes in this group of doctors.

A recently published study showed that burnout syndrome, depression and suicidal ideation have been very prevalent in anesthesiology residents. The deleterious effects

of burnout and depression in residents' psychological health also affect the safety of surgical patients submitted to their care[23].

The Brazilian Society of Anesthesiology (SBA) has shown growing interest in the occupational health of anesthesiologists since 2000. It is a goal of the Society to understand, warn and influence these situations that have significant importance in the life of anesthesiologists and their patients. The actions taken by this Society in this regard were supported by the Committee of Occupational Health of the World Federation of Societies of Anesthesiologists (WFSA), through its Professional Well-being Work Party (PWWP / WFSA).

The Occupational Health Committee of SBA developed an epidemiological survey aimed to assess the levels of occupational stress and the degree of adaptability of residents and their supervisors to the working conditions of Training Programs in Anesthesiology linked to SBA itself and the Ministry of Education. This information was then compared with that obtained in a survey of Belgian anesthesiologists. The main results of this work are summarized in **Table V**[24].

Tabela V - Conclusions do Study of Relationship Among Occupational Stress Level and The Work Conditions: in anesthesiology Training Programs in Brazil

- Second-year residents demonstrated higher percentage of occupational stress than first- and third-year residents or faculty;
- Levels of occupational stress were higher in females;
- The age range presenting the highest level of occupational stress was 25 through 35 years;
- Lower levels of stress were observed among married residents than among their single or divorced peers;
- The number of hospitals respondents worked did not influence the level of occupational stress;
- Alcohol abuse was highly prevalent in sample studied;
- The level of control exerted on the work dynamics, as analyzed on five dimensions, was significantly lower as compared to Belgian anesthesiologists.

Abstract - Recently, in the area of occupational health of the anesthesiologist, knowledge of the risks of somatic and/or psychological diseases aggravated by the stress of clinical practice, improved diagnosis, prevention and management of adverse conditions. However, it is still very important that anesthesiologists be aware of daily aspects of their practice that most cause them psychic and physical stress, as well as understand what improvements can be made in working conditions for the maintenance of optimal occupational health.

Current reality of the correlation between fatigue and Medical Malpractice (responsible for critical incidents)

Occupational fatigue is regarded as a latent cause of medical error, leading to preventable critical incidents which occasionally result in serious consequences [25-26].

Certain characteristics inherent to current anesthetic practice may correlate with psychological pathology. There should be awareness of the risks of acute and chronic fatigue and high levels of occupational stress in the clinical practice of anesthesiologists, as well as residency programs (institutional responsibility).

Recently, Professor Olli Meretoja published the article *We should work less at night*, concluding that:

"There is a growing amount of evidence that physicians' performance is lower if they works excessively long shifts or at night. These working patterns diminish the standard of care and increase health care expenses. Night-time work is non-physiological and poses risks to workers' health. Effective ways of reducing the effects of fatigue include minimizing the amount of work carried out at night and establishing rules on a maximum number of hours for each shift"[27].

The definition of ***stress, occupational distress and fatigue*** helps to understand the correlation between occupational well-being, patient safety and institutional responsibility[1-3].

Stress – physical or emotional tension that develops when there is an imbalance between the demands required of a person and their ability to endure them.

Distress - intense psychic symptoms in response to disruptions in occupational well-being; in the case of health care professionals, mainly depression and anxiety. These symptoms correlate well with decreased professional performance from medical students, residents, clinicians and nurses.

Fatigue - feeling of need to rest (sleep) accompanied by an intense effort to stay awake and significant loss of cognitive and physical capability. Because it is such an unspecific symptom, it is difficult to evaluate and to approach.

Circadian rhythm – the human body functions in 24-hour sleep-wake cycles which influence digestion and endocrine secretion as well as attention levels, emotional and motor performance[3]. Its disruptions have been proven deleterious to anesthesiologists' clinical performance.

A growing number of scientific studies correlate psychopathologic alterations in doctors, residents and nurses (e.g.: high level of occupational stress and its consequences) with the risk of critical incidents (medical error)[4-9].

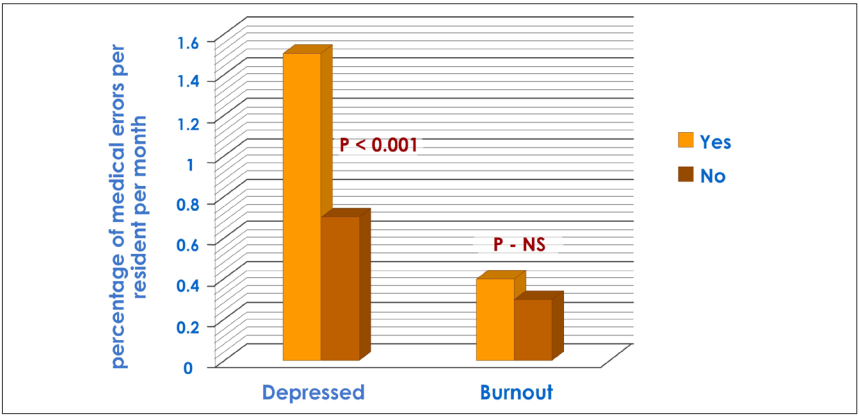
The definition of ***medical malpractice*** is a subject of controversy, but most consensus guidelines consider it a situation in which doctors choose and/or engage in inappropriate attitudes or execute actions incorrectly. Medical mistakes are thus described as *"**human error in the clinical care of patients**"*. However, there is a wide range of severity, and

adverse outcomes are rarely reported or quantified. It is important to mention that malpractice in anesthesiology is usually linked to perioperative critical incidents, which can significantly alter the morbidity and sometimes mortality of surgical patients.

Occupational fatigue can be interpreted as a latent factor, a pre-condition that may influence the incidence of medical malpractice and increase the incidence of critical medical incidents[28].

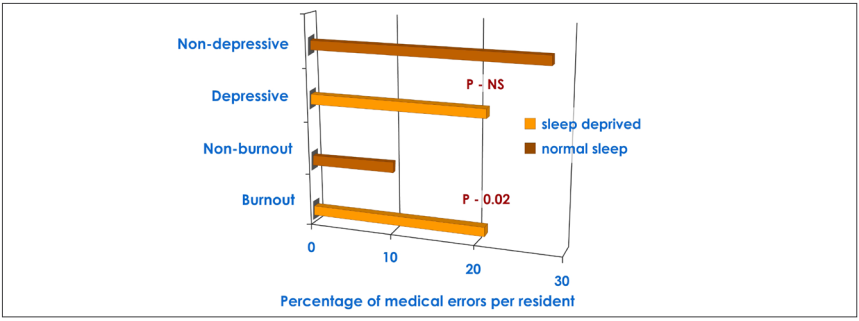
In 2008, the British Medical Journal featured a prospective cohort study on the prevalence of self-reported mistakes in drug administration among residents suffering from depression or burnout. The conclusions were that the incidence of malpractice was higher among depressed residents when compared to those suffering from burnout syndrome and that both conditions are highly prevalent during medical residency[10]. (see **Figures 3,4**)

Figure 3. Incidence of medication errors among depressed and non-depressed residents and those presenting or not presenting burnout syndrome.



Fahrenkopf A M et al. BMJ 2008;336:488-491

Figure 4. Spontaneous report of medical errors of burnout and depressed residents as compared to those not suffering from burnout or depressive symptoms.



Fahrenkopf A M et al. BMJ 2008;336:488-491

Another study showed that the risk of malpractice increases exponentially after nine consecutive working hours. At 24 hours of sustained wakefulness, the impairment in physicians' psychomotor function was equivalent to a blood alcohol concentration of 0.1%, at or above the legal limit for driving in most states of the U.S[29].

Although physical fatigue may be experienced during a day of intense activity, emotional fatigue is seen as the main prompter of medical malpractice among anesthesiologists. It can manifest as drowsiness, impairment of concentration, analysis and decision-making skills, especially in emergency situations. This psychological condition impacts the performance of anesthesiologists worldwide, which may jeopardize the safety of thousands of surgical patients[3].

At present, institutions responsible for controlling basic medical training (medical school), clinical training programs (medical residency programs) and the clinical practice of anesthesiology (medical councils) have been attempting to establish effective preventive measures for psychiatric diseases of occupational origin. Medical trainees as a group are increasingly vulnerable to this type of pathology.

Recently, information about risk factors for somatic and/or psychologic diseases related to stressful clinical practice has improved diagnosis, prevention and management of these conditions[3,4]. Anesthesiologists should be aware of the most distress-provoking aspects of their practice and know what working conditions to strive for. Systematic evaluations of anesthesiologists' well-being and support mechanisms to those in distress, provided by medical associations, control institutions or universities, have been shown to improve precarious occupational health.

Institutional medical councils, national specialty societies and international educational bodies which control the learning and practice of Medicine in the world often define medical error as ***"Inadequate professional conduct which implies technical failure and can cause injury to the life or health of others, characterized by incompetence, recklessness or negligence."***[10]. All causes of occupational diseases in anesthesiologists may have significant impact on the physical and mental health of the medical professional and, consequently, to the safety of the surgical patients. These facts are confirmed by epidemiological studies.

In 1999,*The North American Institute of Medicine* published ***To Err Is Human: building a safer health system***, which showed that more than 98,000 patient deaths were caused by medical error, making it the sixth of the eight most prevalent causes of death in the United States. Medical malpractice is, therefore, potentially more lethal than breast cancer, AIDS and deaths from traffic accidents. This global problem doesn't seem to have been addressed effectively thus far[30].

The aforementioned institute also published, in 2006, the study ***"Sleep disorders and sleep deprivation: an unmet public health problem"***, which concluded that sleep disorders such as insomnia and sleep deprivation have a **cumulative effect**, highlighting the chronic nature of this potential pathology[31].

Another study conducted at *Harvard University* assessed the incidence of adverse events in 30121 patients admitted to emergency rooms in 51 New York hospitals. The estimated incidence of adverse events was 3.7% and 69% of those were due to negligence[32].

Using the same methodology, a study of the Australian health system observed a 16.6% incidence of adverse events, of which 13% resulted in permanent disability and 4.9% resulted in death. Importantly, 51% of these events were identified as **potentially preventable causes** (technical error and/or inappropriate drug administration)[33].

Detailed reviews of adverse events caused by negligence reveal information omission, i.e. most medical malpractice acts go unreported in patient charts.

Employment of a computerized model of compulsory medical reports revealed adverse events in 1.6% of patients hospitalized in Salt Lake City, Utah, U.S.[16]. On the other hand, evaluation based on self-reporting and electronic records showed an incidence of 6.5% in patients admitted to two hospitals in Boston, U.S. 28% of drug-related adverse events were due to medical errors, and 7.3% of them resulted **in serious and potentially preventable sequelae**[34].

Summary - Institutions involved in medical education, regulation of medical practice and occupational health protection have the power not only to improve medical professional health, but also to ameliorate patient safety.

Institutional Responsibility for Anesthesiologists' Occupational Well-being and Surgical Patient Safety

There is a close link between occupational fatigue in anesthesiologists and the incidence of adverse events in surgical patients. A substantial number of studies corroborate that excessive workload leads to a psychologic illness of cumulative character called occupational fatigue and alert to the resultant decrease in efficiency, productivity and safety of anesthesiology practice[1-,6].

The above mentioned studies show that occupational fatigue leads to increased risks for both doctors and surgical patients through multiple mechanisms:

- Lapses of attention and inability to focus;
- Decreased motivation to work;
- Mental confusion;
- Irritability;
- Memory lapses;
- Communication difficulty;
- Slow processing of medical ideas, conclusions and attitudes;
- Slow psychomotor response;
- Emotional indifference and loss of empathy.

Events like excessively long or frequent shifts affect the sleep patterns of health providers and contribute to the increased incidence of medical occupational fatigue. Ultimately, this entails significant decline in professional *performance*, impairing the safety of medical care as well as their own[25.26].

Epidemiological data gathered by the Ontario Medical Association show an increase in the number of psychopathological disorders related to medical practice in comparison with strictly somatic pathologies such as infection, radiation, blood contamination and inhaled gas, as evidenced in **Figure 2**.

Based on the attention given to occupational health, specifically to medical well-being, in Canada, Dr. Michael Myers, Professor of Psychiatry at the University of British Columbia, published a book by the Canadian Medical Association, warning of the risk factors for triggering occupational pathologies. The book was used to raise funds for the diagnosis, treatment and support of occupational diseases in Canada. Certainly, this is an initiative to be followed by other medical institutions in the world[35].

Christopher P. Landrigan (*Director of the Sleep and Patient Safety Program of the Brigham and Women's in Boston*) is mentioned in the text of the *American Joint Commission Sentinel Event Alert* to emphasize the importance of the topic through the following statement: **"We, anesthesiologists, have a culture of long hours of uninterrupted work, and the impact of fatigue on our occupational health is little recognized as an actual issue**."

This and other authors emphasize the need for regulation of the workload performed by anesthesiologists and nurses (day shifts and daily/weekly routine) by the medical institutions, especially institutions with effective executive control over the quality of medical care and medical education. Expansion of epidemiological research in this sector is necessary as well. It is important to highlight the direct correlation of disruptions in sleep patterns and circadian cycle with changes in cognitive performance[36-38].

The report of the American Institute of Medicine - "*To err is human: building a safer health system* reveals another aspect of this issue: medical errors contribute to many hospital deaths and serious adverse events in surgical patients[39].

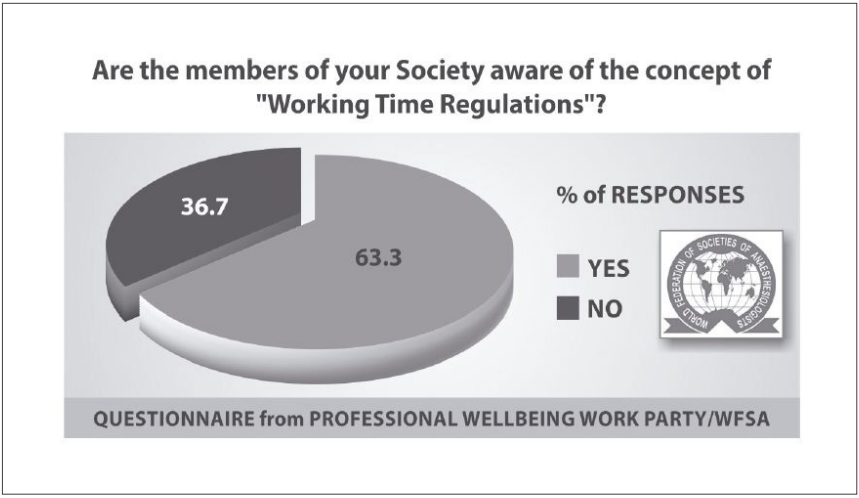
It is extremely important that anesthesiologists be aware of specific aspects of their daily practice that are most likely to cause stress, as well as how to ameliorate working conditions in search of a healthier working life.

Signs of acute or chronic fatigue and high levels of occupational stress should be closely observed during anesthesiologists' clinical practice.

In 2005, the Professional Committee of the WFSA well-being (at the time the Work Party Professional Well-being) conducted a prospective epidemiological cohort study on the occupational health of anesthesiologists in the world, using a questionnaire addressing the presidents of the societies of anesthesiology that are members of WFSA (n. 103), to which 57% responded.

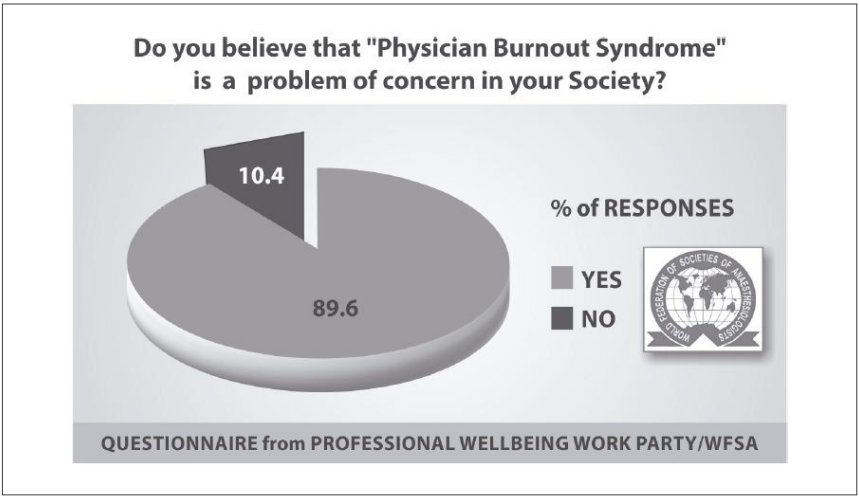
The first question was **"Are the effective members of your Society of Anesthesiology aware of the need for regulation of anesthesiologists' working hours?"**, to which 36.7% of presidents responded negatively and 63.3% responded positively.

Figure 5



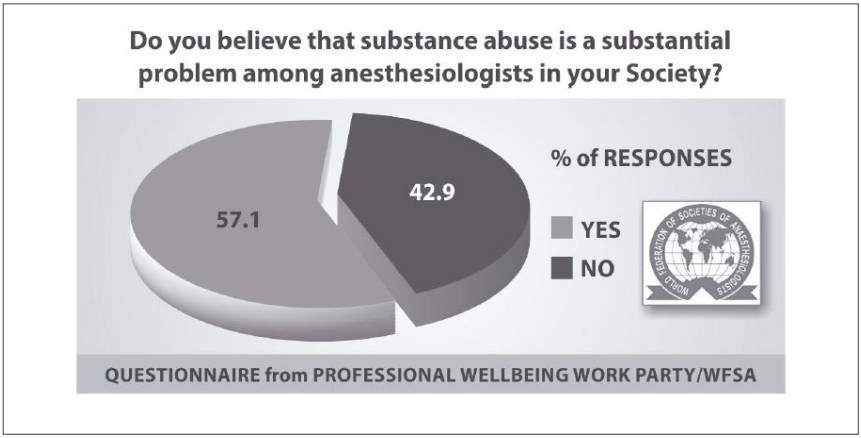
Burnout syndrome was believed to be a significant problem in 89.6% of the cases.

Figure 6



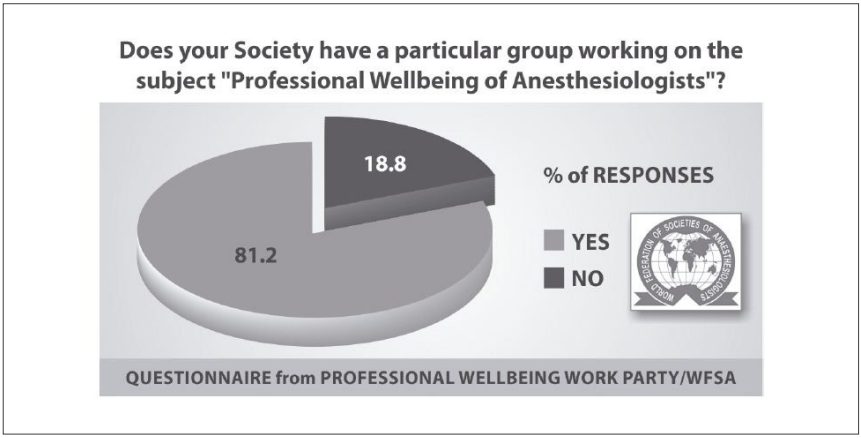
42.9% the presidents thought **drug addiction was a significant problem in their societies**, while 57.1% believed otherwise.

Figure 7



The survey also identified that only 18.2% of societies **had a working group in the area of occupational health of anesthesiologists.**

Figure 8



These results show that national specialty societies are in fact aware of the issue, but there is a wide gap between awareness and preventive actions. This survey by the Professional Well-being Committee of the WFSA is currently underway in its second phase.

Studying occupational fatigue is complex, both in laboratory or clinical environments, due to its multifactorial character, i.e. it varies throughout time according to personality types and other associated conditions, such as burnout syndrome, drug addition, suicidal ideation and high stress levels. Nevertheless, the study of this phenomenon is of utmost importance.

Doctors are trained to focus their attention on the patient, which means they frequently ignore their own health and occupational well-being. They must, however, turn the attention to themselves, since physician psychic health has direct impact on patient well-being. With regard to fatigue, this means learning to identify it and minimize its deleterious effects[11].

Some countries are already taking measures to correct the issue of long working hours leading to fatigue. The Great Britain and Ireland societies of anesthesiology, for example, published a document comprising 25 pages of recommendations on team and patient safety[40]. Similarly, the Australian and New Zealand College of Anaesthetists has also produced a statement on occupational fatigue in which principles and responsibilities are outlined for anesthesiologists and institutions that control medical practice in an effort to diminish fatigue and resultant medical malpractice acts[41].

The workload (shifts and routine) performed by residents has been the subject of several studies. The American Accreditation Council for Graduate Medical Education (ACGME) implemented restrictions on the working hours of trainee doctors, limiting the maximum shift hours in 30 and the workweek at 80 hours. It became clear in subsequent studies that, even so, the risks for surgical patients and for residents themselves remained high, especially in cases of more than 24 consecutive working hours[36,42].

In September 2010, the ACGME has published a final version of the new guidelines, which became effective in the U.S. in July 2011 and can be found at www.acgme-2010standards.org[43].

The *Joint Commission Journal on Quality and Patient Safety*, published in November, 2007, strongly suggests that long working hours and shifts raise the incidence of occupational fatigue, which results in diminished professional performance and culminates in impaired physician and patient safety. This paper revealed that residents who worked in recurrent 24-hour shifts[44-48]:

- Were involved in 36% more preventable adverse effects when compared with colleagues who didn't work more than 16 consecutive hours;
- Committed 5 times as many diagnostic errors as the other group;
- Showed twice the amount of attention lapses while working at night;
- Had 61% more needlestick accidents after their 20th consecutive working hour;
- Exhibited 1.5 to 2 negative standard deviations in their performance when compared to their baseline levels;
- Reported that they had experienced intense fatigue at the time of critical incidents leading to patient death.

In 2009, another study documented that physicians who had had less than 6 hours of continuous sleep had more complications while performing medical procedures at night[49].

Based on the scientific evidence described above, members of the *Joint Commission* recommend some actions for the institutions responsible for controlling the quality of medical practice[37-39, 50-54]:

- To warn, formally and with the aid of scientific evidence, directors of health care institutions about the risks of occupational fatigue and to highlight the need for adequation of workdays and shifts both in frequency and number of uninterrupted hours;
- To emphasize at every opportunity the scientifically proven correlation between occupational fatigue, stress and all their consequences;
- To stimulate partaking of all team members in efforts to plan adequate work regimes, allocating hours in a democratic manner in order to minimize occupational fatigue;
- To create, within medical institutions, plans of action to approach occupational issues, such as:
- Establishing discussion forums;
- Forging mechanisms for effective action about the theme;
- Diminishing the constant use of caffeine during medical practice;
- Establishing routine resting periods of no more than 45 minutes during medical practice;
- Fostering opportunities for medical team members (anesthesiologists) to express their opinions and suggestions about occupational health and workplace satisfaction;
- Creating methods for systematic evaluation of occupational stress levels, as well as providing specialized support for professionals facing those issues;
- Developing financial support systems for anesthesiologists temporarily unable to work due to occupational health disruptions.

Conclusions

Medical literature has shown that the workplace of healthcare professionals is laden with much higher levels of stress than other professional activities. This group of professionals is constantly exposed to work overload, intense social pressure, unclear role definitions, unrelenting clamor from patients and risks of needlestick accidents leading to contamination with infectious diseases. Such physical and psychologic stressors can result in an increase in critical incidents and medical malpractice.

Health care institutions and doctors themselves have been encouraged to take action to diminish stress levels and associated complications. Although institutional intervention is most pressing, combined collective and individual initiatives have more consistent results in the prevention, diagnosis and treatment of occupational diseases.

How can occupational stress be controlled by institutional involvement in order to improve professional performance and safety of anesthetic-surgical care?

Initiatives should focus primarily on the need to limit excessive working hours and to encourage anesthesiologists to partake actively in the planning of healthy and fair working regimes. The result of these should be a more balanced work-life relationship.

Some issues shall be observed in the search for a healthier work regime:

- Night shifts must be reduced in length and frequency and institutional protocols must be actualized to enable strictly urgent procedures to be performed at night, thereby avoiding elective surgeries during that period;
- It is highly recommendable that anesthesiologists of a certain age (>60 years old) be exempted from night shifts;
- Conflicts arising at work must be avoided or minimized through effective and honest team communication in order to establish healthy interpersonal relations at the workplace;
- Institutions must afford social support, showing appreciation and gratitude to medical professionals, and be flexible in their guidelines, maximizing personal capabilities and allowing doctors to reach professional goals without pathological occupational stress;
- Institutions must value to the maximum the opinion of anesthesiologists regarding working regime decision-making.

How can occupational stress be controlled by national or international institutional involvement in order to improve professional performance and safety of anesthetic-surgical care?

Based on the experience described in previous sections, there are two main recommendations:

1. Structuring an agenda for international collaborative research to be funded and developed with the primary goal of generating information on cost-effectiveness of various strategies to improve occupational well-being. This agenda should comprise 3 departments:

a. Research on **factors that alter professional performance**, with the intention to develop testable theories to explain occupational health issues;

b. Establishment of strict methodological strategies to evaluate cost-effectiveness of epidemiological studies regarding occupational health;

c. Assembling of study results in order to develop and implement guidelines about physician occupational health.

This approach should be practiced through constantly updated reviews, publications in peer-reviewed journals and providing free access to electronic libraries. Scientific

information on the subject should reach health care professionals and institutional executive officers ahead of publication.

Detailed results of this strategy and the resultant interventions should be widely available for anyone interested in the subject through internet and peer-reviewed publications.

2. Developing campaigns to engage national health and education ministries and medical education regulating bodies in efforts to transform the information gathered in surveys into effective action to ameliorate the performance of anesthesiologists, targeting the betterment of surgical patient safety and physician occupational well-being. The World Federation of Societies of Anesthesiologists (WFSA), World Health Organization (WHO) and UNICEF (United Nations Children's Fund) are among the institutions that should be involved in action plans.

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- Part 3 -
Biological risks and occupational health

Radioprotection for Anesthesiologists

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Introduction

In the 70's, environmental pollution and toxicity caused by inhaled anesthetics and their metabolites were the main concern of anesthesiologists when discussing occupational risks[1]. Effects of anesthetics and their metabolites on patients, surgical team and anesthesiologist were deeply studied and the issue was discussed in most important textbooks[2, 3]. In the 80's, the main concern became infectious diseases, such as HIV and hepatitis. Nowadays, many scientific publications list a wide range of occupational risks in anesthesiology.

The Brazilian Society of Anesthesiology (SBA) is concerned about anesthesiologists' occupational health. Research, norms and resolutions are frequently published[4] and an Occupational Health Committee was created in order to study and provide information about occupational risks and measures to prevent complications.

In the past, anesthesiologists' exposure to ionizing radiation was occasional, basically when portable X-ray devices were used especially in orthopedics procedures. Currently, anesthesiologists are being exposed to ionizing radiation more often, as anesthesia for diagnostic and treatment procedures becomes more common (interventional medicine, pain treatment, intensive care units and vascular procedures)[5]. Fluoroscopy is now widely used and even anesthesiologists may use it during central venous catheterization and epidural procedures.

Ionizing radiation is an important tool for diagnosis and treatment in many situations, but the transference of high energy associated with it represents a risk. Anesthesiologists are increasingly concerned about radioprotection, which is defined as a set of measures that may protect humans and the environment from the potential hazards of ionizing radiation.

Types of Radiation

Electromagnetic radiation can be classified as ionizing and non-ionizing:

A- Ionizing Radiation - has enough energy to ionize atoms and molecules. X-rays and radioactive isotopes are the most popular types. Gamma ray or alpha and beta

particles are released. Ionizing radiation releases energy such that the affected tissues release free radicals and ionized molecules, which cause cellular destruction, potential chromosomal abnormalities and abnormal cellular growth (neoplastic).

B- Non-Ionizing Radiation - does not have enough energy to ionize atoms and molecules. Microwave heating and laser are examples.

Ionizing Radiation

The effects of ionizing radiation are classified as somatic when diagnosed in an exposed individual or his descendents. Another way to classify ionizing radiation effects is:

1- Probabilistic or stochastic effects: the greater the amount of radiation received, the higher the probability of hazard. Albeit unproven, it is thought that even small amounts of radiation may cause some kind of significant effect.

2- Non-deterministic or non-stochastic effects: these effects only occur when a certain dose of radiation is exceeded. After trespassing that threshold, severity is dose- and time-dependent. The most affected areas are eyes (cataracts), skin (burns), scalp (alopecia) and reproductive organs (infertility).

Exposure to ionizing radiation is commonly measured in REM (Roentgen equivalent in man) units. Natural ionizing radiation exists as well, the level of exposure to it depends on geographic location. Average exposure in the U.S.A. ranges from 80 to 200 milirems (mrem)/year. Cosmic rays are the main source of natural radiation (about 40 mrem at sea level, increasing in higher altitudes). Radioactive compounds found in soil and concrete are also important.

Occupational exposure to radiation (radiology professionals) does not usually reach more than 10% of the maximum dose of 5 REM and the major source of radiation is fluoroscopy.

A single X-ray exposes patients to a 25mrem radiation, far below toxic levels. The amount of radiation generated during fluoroscopy depends on the size of the Rx tube.

Physicists that study radiation recommend that the exposure to radiation be minimized and strategies for radioprotection be followed, especially by healthcare professionals, in order to improve their occupational health[6].

During minimally invasive procedures guided by fluoroscopy, anesthesiologists are exposed to higher levels of ionizing radiation due to proximity to the radiation source[7].

The maximum dose allowed by the International Commission on Radiological Protection, expressed in REM units, is 100 mrem/week and 5rem/ano. Radiation doses are recorded by an individual dosimeter that measures radiation in Gray units. Anesthesiologists do not usually have their own dosimeter unless they are continuously exposed to radiation, as happens during hemodynamic procedures for example. The effects of radiation are cumulative.

Radiation can be reflected by surfaces, increasing exposure levels and occupational risk for people inside the room.

The main hazards caused by ionizing radiation include leukemia, thyroid cancer, cataract and genetic alterations of germinative cells (especially in women), increasing the chance of malformation. Following technical standards is essential for radioprotection, such as protective clothing (heavy and uncomfortable), equipment shields and secure distance from the radiation source, as the intensity of radiation is inversely proportional to the square of the distance. Even with these precautions, skin and eyes are still exposed[8].

Ideally, the patient should be the only one exposed to radiation. The use of fluoroscopy with an energy of 1,5mAmp for ten minutes is equivalent to 69 chest radiographs (0.27 REM is the average dose per radiograph)[9].

Non-ionizing radiation

In medicine, non-ionizing radiation is represented by laser, which can produce infrared, visible or ultraviolet light. Non-ionizing radiation results in different types of damage thanks to its intensity and the release of byproducts of tissue destruction[10].

Laser devices are internationally classified[11] as:

- Class I - Sources that do not exceed the MPE (maximum permissible exposure) to the eyes.
- Class II – Lasers with visible beams, sources with energy higher than 1 mW – eyes are protected by blinking reflex, every 0.25 second.
- Class IIIa – Class II expanded, sources of energy with up to 5 mW radiation – eyes are protected by blinking reflex.
- Class IIIb – High energy sources, up to 0.5 W – direct vision is dangerous.
- Class IV - Sources of more than 0.5 W – extremely dangerous for eyesight.

Most laser equipment used in operating rooms are Class IV.

Eyeball injuries after exposure to direct light or reflected radiation are frequent (corneal and retina burns, optic nerve damage and cataracts). Therefore, protective eyewear with special filters against laser radiation should always be used.

Unlike ionizing radiation, distance from the source of non-ionizing laser radiation does not reduce exposure[12].

Although human skin is less vulnerable than the eyes, exposure to high intensity radiation can cause burns and mutagenesis[13].

Laser vaporizes the tissue and releases an ill-scented smoke that may be mutagenic (similarly to cigarette smoke) and may contain particles of DNA virus. Thus, continuous renewal of the air inside the surgery room is important.

The association of high concentrations of oxygen or nitrous oxide and laser represents an additional risk for anesthesia, as this combination may start a fire. Attention should be paid especially during otorhinolaryngeal surgeries. Precautions to be considered are: avoidance of flammable anesthetics; use of non-reflective instruments (black); oxygen concentrations up to 25%, if possible; use of non-flammable endotracheal tubes (special material or aluminum cover)[11]

Anesthesia Radioprotection

Ultrasound And Mri Rooms

These devices are not sources of ionizing radiation and no specific protection is necessary.

Conventional Radiology Portable Equipment

Radiographs inside the ICU or Operating Suite

These devices have low kilovoltage and milliamperage. There's usually a remote control (long wires, around 2 meters). If the health professional is able to keep a two meter distance of the source, no radioprotection is necessary.

Tomography rooms

CT scanners are just large X-ray equipments and therefore release ionizing radiation. Every professional that needs to stay inside the CT room during the exam (anesthesiologists managing intubated patients) should use a lead cloak, thyroid collar and keep a distance from the source of radiation.

Hemodynamic procedure rooms/ Interventional radiology

These rooms are an extension of the operating suite and require careful cleaning and disinfection methods. X-ray hemodynamics equipment release continuous ionizing radiation throughout the exam.

Once inside the room, it is necessary to use of lead cloak and thyroid collar and keeping appropriate distance from the source of ionizing radiation in order to minimize exposure.

Use Of Laser

Laser is characterized by high incidence of energy per area unit and precise beam direction. Anesthesia for laser procedures in dermatology and ophthalmology are common and eyes and skin are the most vulnerable areas for laser effects. It is essential to use personal protective equipment (protective glasses, clothing and gloves).

Controlling Ionizing Radiation

Radioprotection principles for professionals exposed to radiation are:

- Avoiding unnecessary human and environmental exposure or contamination;
- Keeping exposure levels as low as possible and always below legally permitted limits;
- Continuous evaluation of exposure conditions (usual or accidental);
- Authorization and licensing for the use of radioactive sources;
- Setting dose limits;
- Reinforcing group and individual protection; monitoring individual dosimeters (a group of experts qualified by the Health Ministry should be responsible for that follow-up);
- Complying with the existing legislation regarding radiation use: Law-Decree No 348/89 of 12/10/89 that establishes standards and guidelines for protection against ionizing radiation and Decree No. 9/90 of 04.19.90, as amended by Decree No. 3/92.

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Mechanical Occupational Risks In Anesthesiology

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Anesthesiologists are exposed to a number of occupational hazards as a result of workplace conditions and professional activity, such as toxicity of anesthetic gases, occupational exposure to blood and secretions resulting in risk of infectious diseases, latex allergy, and exposure to ionizing radiation. Other risks involve electrocution, fire and explosions. Recently, new hazards have been identified: drug addiction and burnout, which are difficult to quantify, but may have serious consequences for the anesthesiologist[1].

In general, anesthesiologists are knowledgeable of chemical, biological, physical and psychosocial risks, since information regarding these is widely available in literature. However, mechanical risks are usually only briefly mentioned, which leads to little recognition from anesthesiologists.

According to the Oxford Dictionary of English:
Mechanical – **adjective 1.** operated by a machine or machinery; relating to machines or machinery **2.** (of an action) done without thought or spontaneity; automatic. **3.** relating to physical forces or motion; physical[2].

Occupational – **adjective** relating to a job or profession[2].

Mechanical hazards are associated with poor physical and technological conditions of the workplace that can cause accidents, endanger the physical safety of the worker or inflict damage to machines and facilities[3].

Factors bound to cause accidents include equipment devoid of protection mechanisms, inadequate layout of the workplace, improper or flawed tools, electricity, poisonous animals, frequent shifting of equipment from one place to another, inadequate storage solutions, vacuum-suction devices and others. These factors can trigger occupational accidents, physical stress, fatigue, short-circuits, electric shocks, fires, explosions or occupational diseases[3].

Physical damage inflicted by electrical discharge seems to be the most prominent (43.10%), followed by needlestick injury (33.30%) and colliding against objects/furniture (33.30%)[4].

The Operating Suite (OS) requires a specific set of structural characteristics and equipment that ultimately predispose patients and professionals to various risks,

such as fire (which is exacerbated by the combination of oxygen-rich circuits and electricity-based machinery) and physical injuries by handling heavy equipment and materials, like image intensifiers, as well as various other devices whose handling requires substantial know-how[4].

The risk of accidents in the OS has escalated considerably in recent years due to the increased use of electrical and electronic equipment and the expansion of electrosurgery[5] Most of these accidents are caused by inadequately grounded currents and static electrical discharge[6].

Fires and explosions can be initiated by electrical sparks in a room with highly flammable materials such as rubber and plastic and high concentrations of flammable gases like oxygen and nitrous oxide[8.] Mistaking alcohol gel for conductive gel has also caused explosions with severe burn injuries to the anesthesiologist.

The safety of electrical equipment involves[9]: appropriate maintenance routines with periodic equipment inspection; intact wires and three-pronged plugs, electrical grounding, attention to the connection of the grounding pin to the outlet and avoidance of extension cords and multiple adapters, as well as adequately positioned, sufficiently numbered and good quality power outlets.

In Brazil, there has recently been a change in the pattern of electrical plugs and sockets. As of August 2007, nationwide guideline NBR 14136 determines that there be an indentation in the power socket to prevent the pins from being accessible to touch when partly inserted and that the existence of a third prong for electrical grounding be mandatory[10.] This change enhances safety against accidents[8].

The frequent use of electrical equipment exposes professionals to electric shocks. This can be aggravated by lack of preventive periodic maintenance and equipment wear and tear[5].

Fractures, back pain and varicose veins can be a result of frequent weight lifting when handling and transporting patients or equipment, inadequate posture and frequent spinal flexion activities. Ergonomic factors like equipment design, workplace layout, design of work activity and team communication interfere in the relationship between worker and work[4].

The anesthesiologist's instrument of work, i.e., the anesthesia workstation, has several interconnected elements, such as corrugated hoses and Y-piece connectors. Added to these inherent anesthesia delivery machine components, several other instruments are superimposed: monitors and its cables, transducers and electric power connectors, pulse oxymeter, capnography and electrocardiography cables, BIS sensor cables, invasive hemodynamic monitoring devices' cables and others, which make the station sometimes act as a trap, especially in emergencies, resulting in the fall of these monitors on the anesthesiologist.

The anesthesiologist's workplace is fraught with risk factors that can trigger mechanical accidents, such as needle devices left unpackaged on worktops, the act of break-

ing glass vials, electrical adapters, electrical extension cords connected to multiple pieces of equipment, poor lighting of the rooms and operative field by broken light bulbs, electrical wires on the ground at leg level leading to the risk of falls and the vacuum-suction devices' hoses placed directly on the ground.

Needlestick injuries and falls are among other mechanical risks. The potential for falls is increased when professionals wear clothing bigger than adequate, which can cause tangling in cables.

Other mechanical accidents can occur in the transportation of critically ill patients between hospital units. These patients are usually transported under assisted ventilation, monitored, on beds supplied with oxygen tanks. The stretcher mattress and everything on it (the patient himself, as well as monitors, infusion pumps and fluid bottles) can fall during transport, if not secured properly. Given the tension and urgency of transporting critically ill patients, sometimes the professional helping to carry the stretcher pushes the anesthesiologist against walls, especially in corridors with curves, leading to contusion trauma.

Bruising at the thigh level is common among anesthesiologists due to direct trauma by cranks of operating tables, especially in cases of emergencies where speed is of prominent importance and there is a tendency for anesthesiologists to forego self-preservation concerns.

Most contaminations with blood-borne pathogens that occur in hospitals arise primarily from mechanical injury. Finger cuts caused by breaking of glass vials and needlestick injuries can be prevented by education and protective equipment.

It is noteworthy that mechanical risks in hospitals are especially due to direct assistance from health professionals to patients in varying degrees of severity, which involves handling heavy equipment and needlestick devices, preparation and administration of medications, disposal of contaminated materials in medical waste, interpersonal relationships, irregular work schedules and sleep disruption, the emotional strain from daily contact with pain, suffering and death, among others[11,12].

It is important that trainee anesthesiologists learn how to recognise and protect themselves against mechanical risks inherent to the practise of the specialty.

Control Measures:

Education and training in occupational safety.

The prevention of occupational adverse events entails early recognition of risk situations by staff and improvement in working conditions[1].

The main step towards prevention of accidents caused by mechanical hazards is to conduct safety inspection programs. Through careful examination of all the equipment and facilities, accidents and potentially hazardous situations can be pre-

vented. Preventive and systematic maintenance is the most efficient means to eliminate the risks of mechanical accidents[3].

Before the start of a working day, the anesthesiologist usually performs a checklist of materials and equipment necessary for patient safety. It is advisable that some mechanical hazards are added to it: checking for multiplicity of devices connected to a single electrical socket, ensuring that cables and wires are not blocking circulation areas and that monitors positioned on top of workstations are not unstable.

Definition of Workplace Safety

Occupational safety is an area concerned with raising awareness of the importance of actions to recognize, assess, control and reduce unsafe conditions in the workplace in order to prevent accidents and health injuries to employees.

This area of study investigates risks related to the workplace environment that may affect the employee physically, decreasing their ability to work.

"Workplace safety is a set of resources that aims at reducing the incidence of accidents, therefore it is concerned primarily with preventive measures."

In order to ensure the effectiveness of control measures, it is necessary for anesthesiologists to know the local official safety regulations. Below are a few points of interest in Brazilian Regulatory Standards (RS).

Brazilian Regulatory Standards

The Regulatory Standards for Workplace Safety and Occupational Medicine were approved as Ordinance No. 3214 in 08/06/1978, by the Ministry of Labour and Employment (MLE) - (BRAZIL, 1978). In order for law enforcement to be carried out, both employers and employees need to be knowledgeable about occupational hazards[13].

RS-1 General Provisions

According to the MLE (Brazil, 2002), Regulatory Standards, regarding safety and occupational health, are obligatory for private and public companies and for public institutions of direct and indirect administration, as well as legislative and judicial government bodies whose employees are protected by the Consolidation of Labor Laws (CLL).

1.1.1. The provisions contained in the Regulatory Standards apply, as appropriate, to independent workers, to the entities or companies that employ them and to the unions representing their respective professional categories.

1.7 It is up to the employer:

a) To abide by the laws and regulations on safety and occupational medicine.

b) To issue orders on workplace safety and occupational medicine and to make employees aware of them, with the following objectives:

I- preventing unhealthy acts in the performance of work;

II- publicise the obligations and prohibitions that employees should know and abide by;

III- make employees aware that they will be liable to punishment for failure to comply with orders issued;

IV- determine the procedures to be undertaken in case of occupational accidents or diseases;

V- adopt measures as determined by MTE;

VI- take actions to eliminate or neutralize unhealthy and unsafe working conditions.

c) Inform the workers of:

I- occupational risks that may arise in the workplace;

II- means to prevent and limit such risks and the measures adopted by the company;

III- the results of diagnostic exams to which the workers are subjected;

IV- the results of environmental assessments conducted in the workplace.

d) Allow that employee representatives accompany the surveillance of legal dictates and regulations on workplace safety and occupational medicine.

1.8. It is up to the employee:

a) To comply with the laws and regulations on workplace safety and occupational medicine, including orders issued by the employer;

b) To use personal protection equipment provided by the employer;

c) To submit to examinations as enunciated in the Regulatory Standards

d) To collaborate with the company in the enforcement of Regulatory Standards.

RS-5 – Internal Commission for the Prevention of Accidents (ICAP)

Goal

5.1 The Internal Commission for the Prevention of Accidents (ICPA) - aims for the prevention of accidents and illnesses resulting from work in order to make the preservation of workers' lives and promotion of their health permanently compatible with labour.

RS-6 - Personal Protection Equipment (PPE)

6.1 For the purpose of this Regulatory Standard, Personal Protection Equipment (PPE) refers to any device or product designed for individual use by the employee, for the protection from risks likely to threaten his safety and health at work.

RS-9- Environmental Risk Prevention Program

9.1 Purpose and Scope

9.1.1 This Regulatory Standard establishes the obligation of all employers and institutions that admit workers as employees to design and implement an Environmental Risk Prevention Program (ERPP) in order to protect the health and integrity of workers through the prevision, recognition, evaluation and control of environmental hazards that exist or may come to exist in the workplace environment, taking into account the protection of the environment and natural resources.

RS-10 - Safety in Electricity Installation and Services

10.1 Purpose and Scope

10.1.1 This Regulatory Standard establishes minimum requirements and conditions aiming for the implementation of control measures and prevention systems to ensure the safety and health of workers who directly or indirectly interact with electrical installations and services with electricity supply.

10.1.2 This Regulatory Standard applies to the phases of generation, transmission, distribution and consumption of electrical installations, as well as the stages of their design, construction, installation, operation, maintenance and any proceedings in their vicinity. Official technical standards established by the competent authorities should be observed and, in the absence or omission of those, applicable international standards should then be followed.

10.2 Control Measures

10.2.1 Preventive measures to control the risk of electric shock and other adverse events must be designed through risk analysis techniques in order to ensure the workers' safety and health in all interventions in electrical installations

10.9 Protection Against Fire and Explosion

10.9.1 All areas where there are electrical installations or electrical equipment shall be provided with protection against fire and explosions, as stated by RS-23.

10.9.2 The materials, parts, devices, equipment and systems intended for use in electrical environments with potentially explosive atmosphere must be evaluated for compliance with the Brazilian System Certifications.

10.14 Final Provisions

10.14.1 Employees must interrupt their tasks, exercising the right of refusal, whenever there is evidence of serious and imminent risk to their health and safety or that of others, immediately communicating the fact to his hierarchical superior, who will then ensure that adequate actions are taken.

RS-12-Machinery and Equipment

12.1 Facilities and Areas of Work

12.1.1 The floors of workplaces where machinery and equipment are installed should be inspected and cleaned, whenever they present risks from the presence of grease, oil and other substances that make them slippery.

12.1.2 Circulation areas and spaces around machinery and equipment must be appropriately sized so that processed material, workers and transporters can move around safely.

12.1.3 Among the moving parts of machinery and / or equipment there shall be a free variable range of 0.70m (seventy centimeters) to 1.30m (one meter and thirty centimeters), at the discretion of the competent authority in safety and occupational medicine.

RS-32- Workplace Safety and Health in Health Care Services

32.1 Purpose and Scope

32.1.1 This Regulatory Standard establishes the basic guidelines for the implementation of measures to protect the workplace safety and health of workers in healthcare services, as well as those who perform health care promotion and assistance in general.

32.1.2 For the purpose of the implementation of this Regulatory Standard, the term health care services includes any building intended for the provision of health care to the population, as well as all buildings designated for health promotion, restoration, care, research and health education at any level of complexity .

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Ergonomic Occupational Risks in Anesthesiology

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Introduction

Regardless of external factors, on its own, anesthesia management requires intense physical and cognitive activities, complex manual skills, continuous vigilance, intensive monitoring and precise decision-making. On the other hand, for many reasons, it excels today as a medical specialty capable of offering considerable levels of safety.

These facts aknowledged, two points related to daily practice are still disturbing: the high number of patients who suffer the consequences of professional malpractice related to one or more aspects of the anesthesiologists' responsibilities[1] and the number of anesthesiologists whose physical and/or psychological health have been degraded due to their activities[2].

Anesthetics and opioids, whose pharmacological properties are now considered favorable, are also very potent; monitors often provide information overload; operating rooms (OR) are workplaces with special features and the group of people who work in them is heterogeneous. Thus, sustained attention (vigilance) is necessary and one of the specialty's key aspects. Besides, in many situations, the professional is forced to work under time pressure in order to optimize the OR use. As a consequence anesthesiologists use to work long hours; have to manage cost-related issues; work in a high complexity system; and are affected by the surrounding political, economical and social environment. Thus, fatigue is a potential companion and has been given special attention in recent literature[3,4]. Distinguishing fatigue from other conditions that are frequently correlated, such as **burnout** syndrome, drug addiction, depression, or simply stress, exceeds the scope of this chapter, but negligence regarding functional aspects of anesthesiology daily practice certainly adds risk for developing all those conditions.

The **burnout syndrome** and its frequently associated depressive symptoms afflict a considerable number of anesthesiologists. Burnout is defined as a situation where demands exceed professionals' physical and/or psychological resources. Myers, a psychiatrist and member of the Canadian Medical Association, recommends humanization of the workplace as a prophylactic measure[5]. Humanization is a broad concept; however one should always have it in mind while building a healthy workspace.

Whatever the reasons for human error in anesthesiology practice, its effects on whoever was responsible or associated with it can be devastating and are, undoubtedly, the origin of many occupational conditions and diseases. Ergonomics aims to

decrease the chances for errors by studying the daily tasks and behaviors of those involved in a given profession.

In reality, most operating rooms are projected with minimal consideration regarding the needs of anaesthesiology personnel. When it comes to diagnostic or minimally invasive outpatient procedures performed outside the OR, the situation is even worse. But that is not the only reason why the expression *"ergonomic malpractice"*[6] has been frequently used. Besides physical characteristics of the workplace, lighting and noise, there are other aspects of daily practice that must be considered, such as familiarity with anesthesiology apparel (different types of monitors and other equipment). It is also important to analyze professionals' comfort conditions while performing manual tasks, such as tracheal intubation and vessel catheterization, given the potential musculoskeletal harm. In principle, every routine that brings or augments physical or psychological fatigue must be carefully evaluated.

This chapter will highlight many aspects of anesthesiology practice in the OR that should be better understood in order to avoid medium or long-term hazards to professionals' health and possibly jeopardize patient care.

Ergonomics and the Work of the Anesthesiologist

Ergonomics is the discipline that gathers information about people's needs, characteristics, abilities and limitations, integrating all that to create, develop and test equipment, instruments, systems, routines and protocols[6]. Its main goal is maximizing man-to-man and man-to-machine interface. Applied to anesthesiology, this discipline seeks to optimize work environment, improve performance and offer physical and mental well-being[7].

Taking these aspects into account is important for anesthesiologists' workplace improvement[8]. Not long ago, new equipment and monitors were just piled over older ones, without any concern about optimizing their spatial distribution for better comfort and efficacy of those using it.

In order to achieve its goals, ergonomics analyzes specific tasks, studies the amount of work necessary to perform each task, including analysis of critical incidents, studies attention and vigilance and the role of automation and new technologies[6].

Studies on anesthesiologists' tasks

One of the first studies to analyze the activities of anesthesiologists in an OR was performed by Albert Drui, mechanical engineer at the University of Washington in Seattle. Through a series of videos, he divided them into 24 different categories. Then, he evaluated the time, importance, knowledge, and manual skill necessary to perform each task. The tasks were classified as low, medium or high relevance and grouped according to priority in recreating them. Many recommendations were made after this study, such as the creation of a computerized anesthesia form, suggestions of new locations for sphygmomanometers and new design for anesthesia

equipment; it was proven that 42% of the time was spent on tasks away from the patient and surgical field[9].

After this, a series of studies with the same goals showed similar results. They pointed to the significant amount of time spent on tasks only indirectly related to the patient and for their distribution, influenced by the stage of the procedure. There were different responses to the studies among equipment industries and even professionals themselves, as many of them were resistant to the paradigm-shifting changes[10-14].

Safety equipment to prevent incidents were introduced (disconnection alarms, pulse oximetry, capnography, and automated blood pressure measurement) and the acting profile of the anesthesiologist has been changing. McDonald et al, in 1989, reproduced a study about that which had been conducted originally earlier in the decade. Through videos, McDonald's study revealed an increase in time dedicated to the patient and surgical field, directly (44.8%) or through monitors (14.3%). However, manually recording information on anesthesia forms occupied 10-12% of the time[15].

Anesthesiology practice requires a wide range of skills, experience and knowledge and also different execution times. From venipuncture to extubation, from preparation for a peripheral nerve block to major anesthetic monitoring, each task consumes a variable amount of physical and/or mental work and leads to certain amounts of psychological stress. Considering these aspects, a group of professionals was asked to graduate the difficulties to perform a series of actions into three levels (low, medium or high). This inquiry developed a workload factor for each task[16]. Multiplying this specific factor by the time spent to perform it provided the *task density* of each stage of anesthesia, which is still one of the methods used for measuring work in the OR today.

Studies on anesthesiologists' workload

Workload is an expression created to describe the amount of physical or cognitive resources that an operator consumes to execute a given task[17]. Accessing and analyzing it allows the development of equipment with a more ergonomic design, changes in routine and protocols, and modifications to the work environment. Current monitor screens integrate information and localize it visually, intelligent alarm systems and closed loop controlled infusion pumps are some examples of the application of ergonomics[18]. Evaluating it also allows to measure anesthesiologists' cognitive and physical reserve and, therefore, their aptitude to perform additional tasks. Workload is assessed through cognitive, psychological and physical factors that can result in perception, communication, interrelation or motor overload[6]. Among the methods used for workload quantification, the ones that evaluate professionals' performance when the primary task is modified or when a secondary task is added play an important role.

Simple mathematical problems (secondary task) were presented to a group of residents performing a primary task (anesthesia management) at different moments. The authors, Gaba and Lee, observed that the secondary task performance was compromised in 40% of the samples, because it was simply omitted or because the

professional took an excessively long time to respond. These findings were more frequent during induction and anesthetic recovery, while performing manual tasks, and while talking to the assistant physicians, showing that at least during these moments, residents were overloaded by the primary activity while more experienced anesthesiologists were able to maintain a slightly higher surveillance capacity[19].

Other studies associated techniques to evaluate performance at real time. Weinger[20] analyzed primary tasks during medium size surgical procedures under general anesthesia; a secondary task was introduced (visual vigilance evaluation test); workload was assessed (subjective opinions of the anesthesiologists involved and a single external observer) and task density was measured during anesthesia. The study was performed with two groups of professionals: supervised residents, with only two to eight weeks of experience (11 general anesthesias with tracheal intubation for small or medium size surgeries and duration of up to 4 hours) and third-year residents or anesthetists nurses under limited supervision (11 similar surgeries). The secondary task was the identification of a light signal placed near the ECG monitor that was periodically and randomly triggered by the observer. Every ten minutes the workload was subjectively measured by a numerical scale from 6 (no effort) to 20 (maximum effort required). Study showed that inexperienced anesthesiologists were able to perform fewer primary tasks per minute (lower density of tasks), required more time to achieve almost every task; reported greater overload; spent more time talking to supervisors and surgery team, and had a longer latency time to identify the light signal activation (lower vigilance capability). The periods of maximum overload correlated with lower vigilance.

In this particular study, induction was reported as the period with highest workload, but its intensity and length depended on the type of surgery. It is suggested that during an average anesthesia, high workload is present during 20-30% and low workload in 30-40% of the time when anesthesiologists are physically and mentally active and able to respond to additional tasks[6].

Workload can be assessed by physiological changes presented by anesthesiologists. Weinger[17] tried to assess it in 2004 in two different groups: professionals with or without teaching **responsabilities. During 12 small and medium size sur**geries, assistant physicians were working with residents with different clinical experiences; in the other 12 cases, the professional had no teaching tasks. Holter monitor was used to measure assistants' heart rate changes, adding more information to the assessment of work overload previously done[15]. Results suggested that intraoperative teaching tasks overloaded the instructors (psychologically and in relation to tasks) and may reduce their surveillance capability. However, heart rate was significantly elevated during induction and extubation in both groups, with no significant difference between them. Again, a decrease in task density and workload during anesthesia management in low complexity surgeries was evident.

These studies highlight the differences in intraoperative activities and workload among anesthesiologists with different levels of clinical expertise. During anesthetic induction and recovery, the number of tasks is higher, generally lowering vigilance capacity. During the procedure, the amount of tasks may fall, depending on many factors, such as anesthetic technique, complexity and duration of surgery and the patient's clinical condition. Between these two periods, for example, experienced professionals spend more time observing the surgical field[20], but is that really necessary? It is always valuable to aknowledge the progress of the procedure, but maybe frequent verbal communication with the surgical team can temporarily replace anesthesiologists' prolonged and sometimes monotonous observation, allowing the professional to perform other important tasks, or even a mental short break.

The role of new technologies

The impact on workload exerted by new technologies is another aspect that needs to be considered. Weinger and Gaba[16] studied the effect of using an electronic record of anesthesia and transesophageal echocardiography on task distribution, subjective workload, workload density[6], and surveillance capability, from induction of anesthesia until the start of cardiopulmonary bypass (CPB) in 20 cases of cardiac surgery. Information for ten of these were recorded manually and for the other ten with an electronic system. During induction, there were no differences between groups regarding the number of tasks and the time spent on each. In 16 out of twenty cases, in this period, there were no records on anesthesia form in both groups. When both groups were analyzed together, manual ventilation by mask occupied 24.8% of the time, watching the monitors comprised 18.6%, and drug administration, 9.0%. During the rest of the study, groups differed very little in relation to tasks performed and time spent in each. The electronic recording method group spent less time on this task or setting or watching echocardiography images, and more time watching the monitors. Once again, when the two groups were analyzed together, 24.7% of the time was used for observation of monitors, 11.5% for recording information, 8.1% for adjusting tubes and intravenous infusions and 7.7% for echocardiography adjustments or observation. The subjective measure of workload showed no significant difference whether evaluated by the professional himself or by an external observer. There was also no difference between the groups, but workload was higher during induction/intubation. Regarding monitoring, anesthesiologists from both groups showed greater latency to identify the lit lamp during induction (medium time = 57 sec) than after intubation and until the end of the studied period (31 sec, $P < 0.001$). Then, authors compared surveillance capability of both groups while performing the four most common tasks before CPB. During information recording, there was no difference, but when performing adjustments to the transesophageal echocardiography, examining its images or working in intravenous lines, surveillance capability was significantly reduced in both groups.

There are two divergent trends regarding electronic methods advantages for anesthesia records[6]. On one hand, its use is encouraged in order to decrease anesthesiologists'

workload, allowing more time for other tasks, better observation of the patient and monitors. It could even offer the anesthesiologist some time to rest[21,22]. On the other hand this technology tends to take away the professional's attention from the patient-monitors-anesthesiologist scope, increasing the distance between patient and anesthesiologist and decreasing anesthesiologists' global perception (awareness)[23]. While the anesthesiologist manually uses the monitors to obtain and register patients periodical information, he is always aware of patient's trends and might anticipate and intervene early in possible complications.

In an attempt to assist anesthesiologists during anesthesia management and to help in the decision making process, softwares have been developed to analyze multiple dynamic physiological processes (heart rate and respiratory rate, blood pressure, SaO_2 $EtCO_2$, tidal volume, minute volume) and identify changes in their patterns, considering their statistical properties[22]. Softwares are able to integrate informations on the patient's previous state, context-sensitive half-life of drugs and stages of anesthesia. The information may be categorized as an artifact (sudden change in heart rate caused by the use of cautery), clinically insignificant (elevation of systolic blood pressure 110 to 120 mmHg), clinically significant (increased heart rate from 50 to 90 bpm) or information that requires immediate decision making (SaO_2 fall from 100 to 90%). This promising technology is being developed.

Fatigue caused by alarms

Monitor and infusion pump proliferation brought the noise of countless alarms to the operating room, which may become an important source of distraction. Such alarms are essential to provide security and auxiliary surveillance, but they end up creating challenges and development opportunities for ergonomics. Trigger limits improperly adjusted may cause constant activation of alarms and lead the professional to disregard them and postpone decision-making[24]. It is estimated that 85-99% of triggered alarms do not require clinical intervention, because they were adjusted within narrow ranges; standard limits were not replaced by ones adapted to the patient or population; sensors were misplaced; or there was an interference with other electrical equipment in the room[25]. This creates a daily cacophony of sounds of bells, beeps and horns. As a result, the professional becomes desensitized to the sounds and overload of useless information and may reduce alarm volumes or reset them into values that are not safe[24]. Still, every alarm activation stimulates, consciously or not, the anesthesiologist's brain and consumes energy. Unable to distinguish a false alarm from a real one, the professional deals with two possibilities: becoming fatigued (after so many alarms and intense vigilance) or ignoring the alarm and being at risk for malpractice and its psychological consequences, including guilt, in case an actually threatening situation was disregarded.

An ideal alarm system should: **1)** provide a warning light or sound, whenever a risk to life occurs, **2)** determine whether the limit was exceeded due to the patient or other external factors and **3)** differentiate and report alarms triggered by changes in the

patient from the ones triggered by the equipment and **4**) provide diagnostic information or explain the physiological drive[21]. Its negative predictive value and sensitivity to life-threatening situations should be approach 100%. The positive predictive value and specificity are low even for the most common problems.

Studies of critical incidents

Critical Incidents (CI) are situations where human error occurs and can, if not diagnosed and treated in time, lead to undesirable outcomes, varying from longer hospitalization until death[26]. When reported, their analysis may result in changes in anesthesia practice, new equipment designs, better training and other interventions that increase the safety of anesthesia and tend to improve working conditions. This has been happening for a long time, in other areas of activity, such as aviation[27], based on interview techniques applied voluntarily and anonymously to people involved in procedures deemed unsafe. In anesthesia practice, Cooper[26] in 1978, was the first one to study critical incidents. 359 IC were reported retrospectively by 47 anesthesiologists, residents and nurse anesthetists in a single hospital in Boston, where he based his study. Later, in a new publication, it was extended to five other hospitals in the same city, increasing the number of professionals involved to 139, adding up to 1089 reports of IC[28]. Human error was pointed as the main cause of approximately 70% of IC. Sixty-seven of them resulted in significant damage to the patient; technical errors happened in 28, 23, and 13 judgment errors and mistakes in surveillance. Finally, protocols suggested syringe and drug identification, re-evaluation of anesthesia circuit for preventing disconnection and the use of flowmeters to avoid dangerously low oxygen concentrations. Other common IC causes were inadequate communication among team members, distraction and lowered levels of precautions. Thus, about 20 years before the **Institute of Medicine** published *"To Err is Human: Building a Safer Health System"*[1] which stated that "systems, processes and equipment are commonly prone to failure, leading men to make mistakes or fail to prevent them", Cooper already pointed in that direction[29].

Subsequently, a series of studies with critical incidents reported right after their occurrence, showed similar patterns, again suggesting the presence of human error[30-32]. The use of **checklists** and improvement of specific protocols have been recommended[33] as well as replacing old anesthesia appliances with new ones and formal discussion about IC inside the anesthesia department.

From the late 70's, multiple factors led to significant changes in anesthesia practice, including the creation of national (*Anesthesia Patient Safety Foundation* in *1985* in the United States) and continental instituitions (*Australian Patient Safety Foundation,* in 1988 in Australia and the *Safety Committee of the Association of Anaesthetists of Great Britain & Ireland* in 1974). These institutions prioritize patient safety, but they also consider working conditions and anesthesiologists' health. In 1993, the Australian institution published its findings on the first series with 2000 cases of critical incidents collected from 90 hospitals in Australia and New Zealand[34]. Authors believed

that human errors were involved in 83% of them; and in 17% a better interaction with equipment and devices would have been able to prevent the IC. Then, 111 suggestions were presented to change systems, processes and **equipments; those are generally** included in current anesthetic practice.

Warning and Surveillance

Attention is defined as a "conscious effort to stay alert and able to understand and prioritize information". Monitoring is defined as a "state of sustained attention"[35]. In anesthesia, it can be perceived as a state of consciousness that allows the anticipation and recognition of clinical changes or hazardous conditions[35]. Along with memory and decision-making, surveillance comprises one of the most vulnerable aspects of mental activity – men are known to be bad at being vigilant. Our surveillance ability decreases rapidly and is exhausted after about 30 minutes of continuous monitoring, since severe phenomena (crises) are infrequent and continuous watchfulness for a rare potential event might be boring[35].

As in other areas of activity, vigilance is affected by environmental factors (noise and other types of pollution), personal factors (fatigue, sleep deprivation, boredom, stress, illness, and medication use) and man-machine interface.

Knowledge about brain activity has accumulated since "The decade of the mind" project, a global initiative from 2007[36] that stimulated a multidisciplinary study. Concerned with the cognitive aspects of equipment users, the Human Factors and Ergonomics Society created a multidisciplinary group to study man-machine exchange of information and many decisions arose from it[37]. For anesthesia, a specialty comprised mainly by mental tasks, including a close relationship between man and technological devices, this concern is easily justified and provides arguments for the creation of integrated patient monitoring and anesthesia equipment[38].

Monitoring, one of anesthesiologists' most important tasks, is mainly performed by the human senses of hearing and vision. A study coordinated by Cooper and Cullen proved that auditory vigilance[39] is more efficient than visual vigilance, which was investigated by Loeb[40]. It took 34 seconds (2 to 457)[39] for the occlusion of the chest stethoscope to be noted by anesthesiologists while visual identification of a discrete light signal in the ECG monitor took 61 ± 61 seconds[40], those interventions were made randomly. Simultaneous tasks, critical stages of anesthesia (induction and anesthesia recovery) and conversations resulted in longer periods for the identification of both types of intervention.

Recent studies on human vision show that men have significant visual limitations while they execute simultaneous tasks: **a)** Only a few simultaneous items can be observed and followed, **b)** New objects or unexpected events can be lost or overlooked, **c)** Changes, even when significant, repeated and expected, may go unnoticed and **d)** An observer can not take notice of two alterations at the same time[41].

The layout in which information is displayed on different monitor screens and anesthesia devices may influence anesthesiologists' perception and diagnosis. Easy intake of visual information allows quicker and less energy-consuming decision-making. However, these improvements can only be made by analyzing operators' performance, discussing daily challenges and solution ideas. These limitations should be considered by manufacturers early on in the creative process of a new device model. Standards issued by Medical and Healthcare products regulatory agencies[42] must be observed and publications with guidelines that take human factors into account are already available[43]. For those reasons, ergonomics and human sciences should be combined.

Easy and intuitive interface and operation modes should be a priority while developing any new device. Naturally or through fast learning, every action must be internalized, so that it will eventually become automatic. Another important step in a good project is to restrict the amount of options and possible actions, guiding the user to the best and/or only answer. Finally, the possibility of an operator mistake must always be considered[6]. Compliance with these recommendations is vital upon the surfacing of an anesthetic crisis.

Preparation of drug syringes or infusions and equipment checks require great attention – drug administration errors were responsible for 23% of the critical incidents cataloged by Cooper in 1978[26]. The use of color-coded, standard-format labels for each drug or drug class and the creation of a sequence of individual or institutional preparation of drugs help prevent this type of error.

Carefully designed protocols with precise indication and specialized techniques for the execution of specific manual procedures, such as performing central or peripheral nerve blocks, central venous and arterial catheterization or difficult airway management, improve the performance of anesthesiologists and offers institutional safeguard.

Routines should be planned and established for each and every step of anesthesia practice: from overloaded moments (induction and anesthesia recovery) to the simplest and "tedious" moments. During periods with lower workload, less challenges and less stimulation, secondary tasks or just a change in the sequence of tasks can help the anesthesiologist keep his ability of surveillance[44]. Anesthesia departments should be able to organize short breaks (in between surgeries or with the replacement of the anesthiologist for a short period) for anesthesiologists that are going through moments of boredom or fatigue.

These short breaks can be wisely organized by individuals or institutions. They increase patient safety, since they allow the anesthesiologist to rest his mind and recover watchfulness for new events. Those new events may be complex situations that arise suddenly and require the use of so-called "non-technical skills", such as attention, pre-established mental maps, task prioritization (focus), situation awareness and decision-making[45].

Situation awareness

The concept of situation awareness consists in the ability to be aware of what is happening around oneself and to understand the meaning of each and every incoming information, which will allow prediction and preparation for the next step[46]. An individual who has this ability maintains control over the situation and the environment during complex and dynamic crises, when things change rapidly and time works against him. Situation awareness unfolds in three hierarchical levels: perception (level I), understanding (level II) and projection (level III)[47] and is considered an essential non-technical skill. Ergonomics and psychology, among other specialities, highlight the need for situation awareness. Gaba introduced this concept into anesthesiology in 1995[48]. Several findings and results came from observations and experiments in realistic simulators, always pointing to the relative inability of professionals to handle all the incoming information from different sources. In addition, during crisis situations, the ability to dynamically change the focus and to share the attention and activities with other professionals are critical and commendable characteristics.

Final Thoughts

Anesthesia has developed during its nearly 170 years of existence, and is currently able to offer very high levels of safety. In order to watch over safety, professionals should never exceeded their working capacities, although exposed to long journeys of work, high levels of stress, and many other harmful situations. Stress fatigue and physical or mental occupational illness shouldn't be a part of anesthesiologists life. But just as general practitioners, anesthesiologists are known for recklessness with their own health and a resistance to ask for help when overloaded[49]. That's a current social problem, as healthy anesthesiologists will offer better safety conditions for their patients and the treatment of occupational illnesses costs more than preventive measures[50]. Ergonomics is a science that aims to improve the workplace (making it more practical and comfortable) and offer better and easier information about the patient. Ergonomics can be seen in every aspect of daily practice. Anesthesiologists benefit from the advantages of applied ergonomics through guidelines, specific protocols or guidance for task prioritization. For all that, anesthesiologists should always have ergonomy in mind in order to improve safety of anesthesia and long-term professional health.

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Biological Occupational Risks in Anesthesiology

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Many professional activities may favor contact with biological agents such as bacteria, viruses, fungi, parasites and protozoa. These agents are capable of causing damage to human health through infections, allergic reactions, autoimmune diseases, triggering tumors or malformations.

The operating or invasive medical procedure room is a scenario where the exposure of the health professional to blood and secretions is common and can cause contamination with blood-borne pathogens[1]. A surgeon in business for ten years has a 95% probability of having suffered some kind of contamination in this scenario[2]. Usage of needles with protection mechanisms and of the electrocautery when applicable seem to lessen the chance of contamination among these professionals[3]. On the other hand, few authors have studied the incidence and means of occurrence of contaminations among anesthesiologists and other practitioners of the surgical environment for needlestick injuries or contact with secretions. A multicenter study by Greene *et al.* (1998) investigated the incidence of percutaneous injuries with contaminated material among anesthesiologists and reported that 74% were related to blood contamination and 30% were high risk, having occurred during central venous catheter insertion or blood sampling[4]. Another study of the same group revealed that the majority of lesions reported by anesthesiologists were moderate or severe and most often in the hands[5].

Albeit often coming in contact with blood and bodily fluids or secretions, anesthesiologists frequently fail to report and investigate them properly, treating these events as inocuous even in centers with biosafety programs[2]. In emergency situations or critical moments of hemodynamic instability such as during on-pump heart bypass surgery, a series of mistakes and the intense concern with the patient's life increase the risk of exposure to biological material[6,7].

Needlestick injuries, other percutaneous injuries and contact with body fluids are the most common causes of disease transmission among anesthesiologists in the workplace, and hepatitis C virus is the pathogen most often transmitted to anesthesiologists through contact with contaminated blood from patients[8], mainly through the ocular conjunctiva[9]. Anesthesiologists don't seem to be aware of the risks of biological contamination at the workplace, not even when the patient is considered at high risk of being infected. The fact that pre-operative HIV testing of patients has

not been proven to reduce the incidence of accidental exposure to blood by health professionals corroborates this concern[1].

Therefore, it is necessary to go beyond discussing this issue on specialty conferences and to actually inculcate in trainee anesthesiologists the preventive actions and measures to take in the face of a possible contamination. Although prevention of exposure to blood and bodily fluids is the most effective measure to avoid occupational infections, proper post-exposure conduct is also essential in professional safety.

Risk of Occupational Transmission of Human Immunodeficiency Virus (HIV)

The risks for occupational transmission of HIV are described and vary according to the type and severity/intensity of the occupational exposure[10]. In prospective studies, the average risk for HIV transmission after percutaneous exposure to infected blood is approximately 0.3% (0.2-0.5 / CI: 95%) [11] and after contact with the mucosa it is 0.09% (CI = 0.006% - 0.5%)[10]. Contact with damaged skin seems to entail as much risk as contamination of mucous membranes. The risks associated with occupational exposure to tissues, bodily fluids or secretions from infected patients have not been quantified, but should be less than that resulting from contact with blood. Fluids considered potentially infectious are: cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid and amniotic fluid. Feces, saliva, sputum, sweat, tears, urine and vomit are not considered infectious unless they contain blood[11]. Compared with exposition to hepatitis B or C viruses, the probability of contamination with HIV is much lower.

Epidemiological and laboratory studies suggest that multiple factors are responsible for the risk of HIV transmission after occupational exposure. In a retrospective, case-control survey of health professionals who had percutaneous injuries with HIV-infected blood, the following characteristics were associated with higher risk:

- gross contamination of the needle (or perforating material) with blood of infected patients;
- intravenous or intra-arterial location of the needle involved in the accident;
- depth of the wound;
- contamination with blood from patients with end stage disease;
- amount of contaminated blood.

Quantification of plasma viral load (RNA/HIV) reflects only the level of free virus (i.e. not attached to cells) in peripheral blood. However, cells with latent infection can transmit the disease even in the absence of viremia. A low (<1500 RNA copies/ml) or undetectable viral load probably indicates exposure to low titers of virus, but do not exclude the possibility of transmission[10].

Even though the risks of HIV infection are low in comparison with Hepatitis B and C and the human immunodeficiency virus resists poorly to sterilization methods, it

must be stressed that the devastating characteristics of the disease and the absence of a vaccine to prevent it mandate strict contamination prevention measures, according to the *Centers for Disease Control* (CDC), Atlanta, U.S.[10] and the Ministry of Health in Brazil[12] :

- wearing (double) gloves and washing the hands immediately after removing them;
- wearing masks, goggles, aprons and boots;
- refraining from reinserting needles in covers or removing needles from syringes: once assembled and used, they should be placed in appropriate disposal sites;
- sterilizing all anesthesia materials in ethylene oxide or hydrogen hyperoxide;
- avoiding mouth-mouth resuscitation;
- prevention of contact of professionals with exudative lesions or exfoliative dermatitis with patients or used materials;
- all materials with blood must be transported in suitable containers without leakage;
- isolation of bodily substances, using barriers.

Post-exposure Prophylaxis of the Health Professional

Upon occurrence of percutaneous or mucous membrane exposure to patient blood or bodily fluids, one should:

- wash the area vigorously with soap and water and disinfectant solutions;
- the ocular surface must be rinsed with water and saline solutions suitable for eyes;
- performing serologic testing in the patient;
- performing serologic testing in the professional every 6 months for 2 years;
- reporting the incident to the local infection committee.

Regarding Post-exposure Prophylaxis (PEP), the initiation of antiretroviral therapy quickly after exposure can prevent or inhibit systemic infection by limiting the spread of the virus to target cells or lymph nodes[13]. Animal studies are complex to design and difficult to interpret due to the choice of species that are comparable to men, choice of viral strain, size and route of the inoculation sample, but according to those, prophylaxis appears beneficial[14, 15]. The few studies carried out in humans show seroconversion after occupational exposure as a rare phenomenon. In a retrospective case-control study, Zidovudine® reduced the risk of infection by 81% (95% CI = 42-94%)[16] In another multicenter study, administration of the same drug to infected women during pregnancy, labor and birth reduced vertical transmission by 67%[17]. Nevertheless, there are reports of failure in prevention: 16 cases with Zidovudine® as a single agent, 2 cases when combined with Didanosine® and 3

cases when three classes of drugs were combined. These treatment failures were associated with high titers of viral load, size of inoculation, late onset, short duration, characteristics of the physician who had the accident (immunodeficiency) and viral strain[10].

Out of five classes of drugs available for treatment of HIV infection, only the ones approved by the FDA (nucleotide reverse transcriptase inhibitors, non-nucleotide reverse transcriptase inhibitors and protease inhibitors) are available for prophylaxis, which is administered according to the risk of transmission.

With regard to the type of exposure, in the case of superficial lesions or those with solid needles, PEP is recommended with two classes of drugs when the infected patient is type 1 [i.e. asymptomatic or with low viral load (<1500 RNA copies/mL)] and with three or more classes of drugs when the infected patient is type 2 [symptomatic, with immunodeficiency syndrome, acute seroconversion or high viral load]. In all cases, the start of PEP should be immediate. For situations when there is no serology (deceased patient), PEP is not recommended; however, one can institute PEP with two drugs in case the patient had risk factors for HIV. Likewise, when contamination occurs with needles from containers, the risks and benefits of PEP should be discussed with the exposed person. Moreover, in accidents resulting in serious injuries and/or with large amount of blood, PEP is modified to three classes of drug, even if the infected patients are asymptomatic or have low viral load[10].

In cases of exposure of mucous membranes or skin lesions to contaminated blood, PEP will be defined by the volume of blood (drops *vs.* great quantity). Small amounts of blood suggest the use of two classes of drugs for exposure with blood from type 1 patients and recommends the use of 2 drugs for exposure with blood from type 2 patients. When the accident involves large amounts of contaminated material, the recommendations include 2 drugs for type 1 patient material and 3 classes of drugs for type 2 patient material. PEP is not recommended when accidents involve patients with negative serology, whether they be percutaneous or contact with mucous membranes or skin lesions[10].

The indicated PEP regime should be initiated as quickly as possible after the accident and reassessed 72 hours after exposure, especially when there is additional information about the patient. Medications should be administered for 4 weeks if tolerated, and in the face of a negative serology, the regime should be discontinued. Due to the toxicity of the agents used, one should always weigh the risk/benefit ratio of PEP, especially when three classes of drugs are to be employed.

The exposed professionals must be accompanied, advised and submitted to medical evaluations, especially those who are receiving prophylaxis. They must also undergo serology tests at least once at six months post-exposure (6 weeks, 12 weeks and 6 months) or when facing an acute retroviral syndrome.

Occupational Risk of Transmission of Hepatitis B and C Viruses

Viral hepatitis is a major public health problem worldwide, including Brazil. According to estimates, billions of people have had contact with hepatitis viruses and millions are chronic carriers. The liver is the primary target of these pathogens, but systemic dissemination of the disease occurs occasionally. Despite the clinical similarities between the various types of viral hepatitis, there are fundamental differences in their etiology, epidemiology and pathophysiology[18].

Viral hepatitis is designated by letters of the alphabet: hepatitis A (HAV), hepatitis B (HBV), hepatitis C (HCV), hepatitis D (HDV) and hepatitis E (HEV). There are other hepatotropic pathogens, such as the causative of *non-A, non-E hepatitis*, still unidentified[19]. Several other pathogens such as cytomegalovirus, rubella, yellow fever, herpes virus, and varicella can infect the liver and result in hepatitis virtually indistinguishable to the classic conditions cited above[20].

The hepatitis B virus (HBV) can cause acute and chronic infection, cirrhosis, hepatocellular carcinoma, liver failure and death[2 3]. Millions of people are affected annually, and it is a significant public health problem worldwide, since HBV is responsible for about 4,000 to 5,000 deaths a year in the United States, from cirrhosis or liver cancer.

Transmission of hepatitis B virus (HBV) is parenteral and sexual, it is considered a sexually transmitted disease. Hepatitis B can this be acquired through cuts (skin and mucosa), unprotected sex and parenterally (through sharing of needles and syringes, tattoos, *piercings,* dental or surgical procedures, etc...). The magnitude of occupational hazard with the hepatitis B virus is 40 to 60%[21].

The hepatitis C virus (HCV), formerly known *non-A, non-B hepatitis*, was responsible for 90% of cases of hepatitis transmitted by blood transfusion without a recognized etiologic agent. The causative agent is an RNA virus of the family *Flaviviridae,* which may present as asymptomatic or symptomatic. On average, 80% of the people infected with the virus cannot eliminate it and evolve into chronic forms. The remaining 20% eliminate the virus within a period six months from the onset of infection.

When there is exposure to patients infected with hepatitis C and those of unknown serology, monitoring of the health professional is recommended. Occupational accidents involving the hepatitis C virus (HCV) only result in efficient transmission through blood. The average incidence of seroconversion after percutaneous exposure to blood known to be infected with HCV is 1.8% (range 0-7%)[21].

Since the incubation period of hepatitis C lasts about 7 weeks and the vast majority (> 75%) of acute cases are asymptomatic, laboratory investigation is necessary for diagnosis. About 70 to 85% of cases of contamination by HCV progress to chronic disease.

The flowchart for Victims of Occupational Accident with Biological Material should be applied and notified. The health care professional should stop the procedure and

request a colleague for replacement, wash the wound with water and soap (skin) or saline solution (mucosa), identify the source and communicate the immediate supervisor. Then assess the individual occupational hazard[22]:

Step 1: Care locations

- Percutaneous or cutaneous exposure:
- Wash exhaustively with soap and water
- Use antiseptic solution (chlorhexidine or PVP-I)
- Mucosal exposure:
- Wash exhaustively with water or saline solution

Contraindicated measures: procedures that increase the exposed area such as cuts and local injections and irritant solutions such as ether, hypochlorite and glutaraldehyde.

Step 2: Exposure Assessment

- Biological material with HBV:

Blood is the material with highest titers of HBV. Milk, bile, cerebrospinal fluid, feces, nasopharyngeal secretions, saliva, sweat and joint fluid are not good transmitters of HBV.

- Biological material with HCV:

Blood is the only efficient transmitter of HCV

Other biological materials pose unquantified risks. There is significant risk of transmission by contaminated surfaces (fomites).

Step 3: Source Evaluation

- Known source with known serologies or available for blood testing
- Source with unknown serologies and unavailable for testing
- Unknown source

Step 4: Specific Management of Hepatitis B

Risk of transmission after accidental exposure to blood:

a) HBeAg positive (replicating):

- 20-30% clinical hepatitis
- 35-60% serological evidence

b) HBeAg negative (non-replicating):

- 1-6% clinical hepatitis
- 20-35% serological evidence

When faced with accidents with HBV risk:

- Unvaccinated health care professional:
- HBV-positive source: immunoglobulin + start vaccination regime
- HBV-negative source: start vaccination regime
- Unknown or untested source: start vaccination regime

Immunized health care professional (Anti-HBs> 10mUI/mL):

- HBV-positive, HBV-negative or unknown source: no specific measures

Carneiro *et al.* (2003) found a prevalence of HBV infection among anesthesiologists of 8.9% (anti-HBc).

Specific management of HBV vaccine:

- Vaccination is very effective (90 to 95%) - (anti-HBs +)
- 10% do not respond to three doses: repeat 3-dose regime
- 40% remain non-responders: orientate
- Regime: 0, 1 and 6 months
- Vaccinate all health professionals as a PRE-exposure measure
- Pregnant and breastfeeding women can be vaccinated

Specific management for HCV

- There are no postexposure prophylactic measures
- The professional should be counseled, tested and monitored serologically
- There is no vaccine

When faced with accidents with HCV risk:

- follow-up with serology and liver enzyme testing
- ideally, evaluate PCR/RNA with sensitive tests

Step 5: Follow-up clinical and serological

- Length: 6 months to 1 year
- Guidelines in case of contamination: using condoms, not donating blood or tissues, avoiding pregnancy, discontinue breastfeeding

While any professional category may be at risk, surgical healthcare professionals (including anesthesiologists), paramedics and emergency care providers are considered a high-risk group for occupational exposure to biological material.

Knowledge of safety standards and their applicability should be routine in the clinical practice of anesthesiologists.

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Exposure to Inhaled Anesthetics

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History

The teratogenic effects of inhaled anesthetics were initially studied in 1910 by Stockard [1], but concerns about the consequences of prolonged exposure to its residues only arose in the late 1960s in the Soviet Union, Denmark, England and the United States. Articles published in the Brazilian Journal of Anesthesiology over the 1970s revealed growing concern over the issue in our country[2,3].

In 1967, health examinations were performed in 198 male and 110 female anesthesiologists from the former Soviet Union, all of whom used ether, N_2O and halothane in their daily practice[4]. High levels of headache, fatigue and irritability were reported, as well as the first published cases of adverse effects on human reproduction: 18 out of 31 pregnancies resulted in spontaneous abortion and congenital malformation. Later that year, Fink demonstrated the adverse effects of N_2O on the reproduction of rats by showing that high blood concentrations of that gas resulted in increased incidence of skeletal abnormalities[5].

Also in 1967, Parbrook reported cases of previously healthy patients who developed bone marrow depression after chronic exposure to N_2O[6].

In 1968, a study on the cause-specific mortality of 411 American anesthesiologists over a 20-year period found low incidence of lung cancer, normal incidence of leukemia and higher incidence of lymphatic malignancies compared with the general population[7].

Another research in 1973 showed that the incidence of cancer among American nurse anesthetists was 1.33% higher than the control group (0.4%)[8].

Later, in 1981, the American Society of Anesthesiologists published a booklet called "Waste anesthetic gases in operating room air: A Suggested program to reduce personnel exposure"[9].

Although animal experiments have exhaustively demonstrated the potential teratogenic and abortive effects of inhaled anesthetics, contradictory data can still be found in the literature concerning variability in individual response to different volatile agents. Moreover, experimental data from animals cannot be extrapolated to humans and the results of these studies might be due to other environmental factors aside from exposure to inhaled anesthetics.

Toxicity Mechanisms of Inhaled Anesthetics

Direct and Indirect Effects

Only N_2O has direct toxic effects; the toxicity of other inhaled anesthetics derives primarily from hepatic and/or renal metabolites or from byproducts of their degradation in the CO_2 absorber.

Volatile anesthetics can impair hepatocellular metabolism to varying degrees in humans. The metabolism of these anesthetics results in tissue acetylation by intermediate reactive substances. Acetylated proteins may lead to antigen formation and induction of immune response. The probability of post-operative liver damage depends on the chosen anesthetic and its metabolism rate, which is considerably higher with halothane[10].

High plasma concentrations of inorganic fluorides are associated with nephrotoxicity[10].

Sevoflurane is known to interact with components of the CO_2 absorber to form potentially toxic compounds. Compound A (fluoromethyl-2 ,2-difluoro-1-(trifluoromethyl) vinyl ether) is nephrotoxic in rats, but hasn't been proven to cause renal disorders in humans[11].

Prolonged exposure to nitrous oxide leads to irreversible oxidation of vitamin B12, causing depression of the activity of methionine synthase and megaloblastic erythropoiesis[12].

Metabolism Byproducts

Modern volatile anesthetics undergo minimal degradation and therefore have a very low degree of systemic toxicity. Inhaled anesthetic toxicity is directly correlated to solubility in blood and other tissues.

About 20% of inhaled halothane is metabolized in the liver by cytochrome P450 2E1 and 2A6. In the presence of oxygen, trifluoroacetic acid and small amounts of fluorine, chlorine and bromine are formed. Only a small portion of halothane, approximately 1%, is metabolized through reduction by cytochrome P450 2A6 and 3A4. This becomes the preferential route during hypoxia and results in the release of fluoride and volatile organic compounds[13].

About 5% of enflurane undergoes biotransformation in liver, yielding difluoromethoxy-difluoroacetic acid which is an analogue of trifluoroacetic acid[14].

Cytochrome systems P450 2E1 and 3A contribute to the metabolism of isoflurane, which is approximately 0.3%. Trifluoroacetic acid is also formed as an intermediate compound[15]. Likewise, 0.02% of desflurane is metabolized into inorganic fluoride and trifluoroacetic acid[16].

The degree of metabolism of methylethyl ethers is lower than that of halothane. Consequently, liver damage ascribed to these anesthetics is very rare.

Sevoflurane is metabolized by cytochrome P450 2E1 at a rate of 2%[15], but unlike other halogenated agents, it does not result in trifluoroacetic acid formation. The byproducts of sevoflurane metabolism are inorganic fluorides and hexafluoroisopropranolol. The latter is rapidly conjugated with glucuronid acid and excreted in the urine. Inorganic fluorides are produced at higher rates than those produced by enflurane metabolism, but sevoflurane's low solubility and rapid elimination make total exposure to inorganic fluorides after sevoflurane less than after enflurane[17].

Byproducts of the reaction with CO_2 absorbers

All halogenated anesthetics may react with components of CO_2 absorbers. Potassium hydroxide (KOH) and sodium hydroxide (NaOH) are the main reactive components. High temperature and desiccation of the absorber catalyze degradation reactions.

Contact of desflurane with desiccated absorbents containing KOH and NaOH results in the formation of high concentrations of carbon monoxide (CO). This also occurs with other halogenated anesthetics, but in smaller quantities than with desflurane[18].

Compound A is the byproduct of the interaction of sevoflurane with KOH and NaOH. It occurs most in low-flow and closed-circuit anesthetic systems and correlates directly with temperature, desiccation and concentrations of CO_2, KOH and NaOH in the absorber[19].

Exposure of desiccated soda lime to sevoflurane has resulted in significant amounts of methanol and formaldehyde in the breathing circuit[20].

Toxicity in Specific Organs

Hepatotoxicity

About 20% of halothane undergo biotransformation in the liver. The first large retrospective study on the association of halothane with liver damage reported an incidence of fatal liver necrosis in 1:35.000 anesthetic procedures[21]. Repeated anesthesia was shown to be a risk factor for this relatively rare and fatal complication. In contrast, a moderate form of hepatocellular damage was observed in 20% of patients exposed to halothane[22]. This study provided evidence that fulminant hepatitis induced by halothane is an immune response to haptens, which are the combination of intermediate compounds with macromolecules.

Even though halothane was linked to severe hepatic dysfunction only a few years after its introduction, low price and arguments that the incidence of liver complications was low ensured it remained in the market.

Enflurane, isoflurane and desflurane may also be responsible for fulminant hepatitis in susceptible patients, but its occurrence is even rarer than that observed with halothane[14,23,24].

Sevoflurane is metabolized differently from other halogenated agents and its administration is safe regarding the possibility of hepatotoxicity.

Nephrotoxicity

Sevoflurane is metabolized to inorganic fluoride and hexafluoroisopropanol in the liver. Animal studies reported that plasma concentrations of inorganic fluorides following anesthesia with sevoflurane were approximately half of those observed after methoxyflurane anesthesia[25].

Methoxyflurane was associated with early, severe and dose-dependent renal damage, which resulted in its withdrawal from clinical practice. A large percentage of methoxyflurane remained in adipose tissue during anesthesia, which sustained high serum concentrations of inorganic fluorides for hours after anesthesia. Sevoflurane, on the other hand, is quickly removed due to its low blood and tissue solubility.

Repeated low-flow sevoflurane anesthesia in dogs resulted in no change in renal function and rapidly normalized serum fluoride[26].

Pollution of Operating Rooms

Occupational exposure to inhaled anesthetics has often been associated with diseases, worsening of psychological functions and reproduction function toxicity. However, the evidence for these associations is derived from epidemiological studies that have been criticized.

Sources of Pollution

Ideally, all operating rooms should have air exhaust systems, since numerous sources of pollution result from the administration of inhalational anesthesia. Virtually inevitable sources include leakage from ill-fitting face masks, uncuffed tracheal tubes, laryngeal masks, ventilator systems, pediatric respiratory systems, samples of gas analyzers, the oxygenator of the cardiopulmonary bypass machine and the air exhaled by the patient at the end the procedure. Potentially avoidable sources are outpouring of liquid anesthetic during vaporizer refill and failure to stop N_2O or vaporizer flow when the system is not connected to the patient[27].

Exposure Levels

Inhaled anesthetic concentrations in room air escape depend on anesthetic gas leak and the amount of fresh air introduced into the environment. However, there may be spatial and temporal variation because the mixing of volatile anesthetics in air is nei-

ther immediate nor complete: concentrations tend to be higher near the anesthesia delivery machine, where the anesthesiologist stays.

In operating rooms devoid of ventilation and air conditioning systems, the concentration of N_2O is 1000-3000 ppm, while those furnished with this kind of system show N_2O concentrations of 200-500 ppm. Installation of air exhaust systems in these rooms reduces this concentration to 100-300 ppm and 15-35, respectively[28].

Government agencies have recommended maximum exposure standards. The maximum N_2O concentration in Europe is 100 ppm for 8 working hours/day. In the United States, for the same workload, the maximum level is 50 ppm (as determined by the American Conference of Governmental and Industrial Hygienists - ACGIH) and 25 ppm when N_2O is used as a single agent (as determined by the National Institute for Occupational Safety and Health - NIOSH). The concentration limit for other inhaled agents in Europe, considering 8 working hours/day, is 10 ppm to 50 ppm for enflurane and isoflurane. In the U.S., the ACGIH considers 50 ppm for halothane and 75 ppm for enflurane[28]. In France, the limit for occupational exposure is 25 ppm for N_2O and 2 ppm for other volatile agents. In general, maximum values range from 25 to 100 ppm for N_2O and 0.5 to 20 ppm for volatile anesthetics, depending on specific agent, exposure time and country[29].

Monitoring

Occupational exposure to inhaled anesthetics has been quantified by chromatography and infrared spectrometry of room air collected in dosimeters[27].

Direct measurements in exposed workers have been carried out by chromatography of urine samples. Another method to analyze real time exposure is analysis of exhaled gas through proton-transfer-reaction mass spectrometry[30].

Pollution control

Efforts should always be made to minimize sources of contamination. Operating rooms should be equipped with air-conditioning, non-rebreathing exhaust systems with high suction flow. Recommendations for operating room air renovation are 15 to 21 exchanges per hour, with a minimum input of $50m^3$ per person per hour.

Potential Hazards

Organ Toxicity

As previously mentioned, the organs most affected by volatile anesthetics are the kidneys and liver. Beta-lyases present in the kidney act upon compound A to form olefins that are toxic to the proximal tubule, and toxicity on the collecting duct is caused by fluoride ion. The threshold for nephrotoxicity of compound A is 300 ppm/h in rats and 600 to 800 ppm/h in monkeys, animals with beta-lyase activity 30 and 1.5 greater than that of men, respectively. During sevoflurane anesthesia with fresh gas flow of 1L/min, the concentration of compound A in soda lime does not exceed 20 ppm. Given that there was no renal damage with fluoride levels of less than 50 μM/L, this was postulated to be a threshold for inorganic fluoride nephrotoxic-

ity[31]. And as for hepatotoxicity, evidence suggests that the fulminant form is immuno mediated and results from trifluoroacetic acid action, while the less severe form of hepatitis occurs by direct action of volatile anesthetics on hepatocytes.

With respect to chronic exposure, a study that evaluated the serum and urine concentrations of inorganic fluoride in 10 anesthesiologists over a 2-year period found that serum levels ranged from 0.2 to 7.9 μM/L. These professionals worked in operating suites with non-rebreathing air conditioning and exhaust systems with 12 exchanges/hour[32]. In Brazil, a cohort study performed serial measurements of serum inorganic fluoride for a period of 18 months in ASA I anesthetists aged between 28 and 43 years, who had been working for 6 to 17 years with a daily exposure between 8 and 12 hours in operating suites without anti-pollution systems. Average serum fluoride levels were 7.24 μM/L, ranging from 6.17 to 12.95 μM/L, with peak concentrations up to 40.82 μM/L. Average serum fluoride in inhabitants of the cities where these physicians worked was 2.74 μM/L. Serum fluoride levels did not return to normal in these professionals, even when they were away from work for periods of thirty days[33]. Reevaluation of the same anesthesiologists after 5 years evidenced unchanged plasma concentrations of fluoride (7.48 μM/L), but laboratory tests showed no tubular dysfunction[34].

Genotoxicity

Genotoxicity resulting from occupational exposure to inhaled anesthetics is still debatable. Markers of genotoxicity include chromosomal aberrations and micronuclei formation, as well as sister chromatid exchange. Increased micronuclei in lymphocytes have predictive value for cancer risks and sister chromatid exchange is associated with fetal malformations and frequent miscarriages. Studies show increase in these markers especially after exposure above the recommended levels. Exposure to low levels of sevoflurane (0.2 ppm) or isoflurane (0.5 ppm) increases sister chromatid exchange rates, but doesn't influence the formation of micronuclei. These changes disappear within 2 months of detachment from the operating suite. Other factors such as stress, smoking and exposure to ethylene oxide also generate these types of changes [29]. Chromosome alterations are found more frequently in non-smokers exposed to inhaled anesthetics. Among smokers, however, the incidence of these changes is already high and does not depend on exposure to anesthetics[35].

Carcinogenesis

Studies show unchanged incidence of cancer among anesthesiologists. In animals, carcinogenic risks were demonstrated after 2 years of exposure to low concentrations of N_2O and halothane[28]. Some studies conclude that only older anesthetics such as trichlorethylene, chloroform and fluroxene exhibit carcinogenic potential in rodents when administered in high concentrations[27,28].

Reproductive Toxicity

Fertility: Recent meta-analyses have shown increased risk of spontaneous abortion and congenital malformations in nurses exposed to inhaled anesthetics. However,

this association was not as evident in well conducted studies and the significance of these findings was limited by the number and heterogeneity of the included studies[36].

Mutagenicity: Toxic effects during fetal formation. Scientific evidence suggests that the inhaled anesthetics currently used are not mutagenic[28].

Teratogenicity: Toxic effects during fetal development. N_2O is the only anesthetic experimentally proven to be teratogenic. Administration of concentrations of 50% for 2.4 to 6 days or 70% for 24 hours in pregnant rats during the period of organogenesis resulted in an increase in visceral and skeletal abnormalities, as well as the administration of low concentrations (0.1%) throughout pregnancy in rats. However, these conditions would be unlikely to be reproduced in humans[27,37].

Two of the main factors associated with N_2O teratogenicity are its inhibitory effect on methionine synthase and its sympathomimetic effects. In humans, however, the teratogenic potential has not been well established[37].

Psychophysiological Effects

Most studies failed to show significant change in cognitive or motor function after exposure to various concentrations of N_2O, with or without halothane, when compared to baseline or control cases[28].

Types of Study and Interpretation of Cause and Effect

Epidemiological studies evaluate cause-effect relationships. The indicated epidemiological study design depends on the hypothesis to be tested. In occupational medicine, sequential measures are essential, as well as cause-effect relationships. A cause is denominated sufficient when it inevitably produces or initiates an outcome, and it is called required when the outcome cannot occur in its absence[38]. Although research almost always detects a disease to then search its causes, it is also possible to identify a potential cause, such as air pollution, and investigate its effects.

In order to study occupational diseases, research is necessary and mandatory and should focus primarily on chronic exposure.

The majority of studies that assess chronic exposure to operating suite air are qualitative rather than quantitative, based on interviews and readings. Purely descriptive studies fail to analyze possible associations between exposure and its effects. It is also worth noting that operating suite professionals are not only exposed to inhaled anesthetic waste, but also to other chemical, physical and biological agents that can interfere with study results. Other bias sources to be considered are exposure magnitude variance, age, nutritional status, obstetric history, smoking and alcohol consumption.

Quantitative studies are, therefore, the most appropriate study design for analysis of inhaled anesthetic exposure in operating suite air. Observational studies such as analytical surveys and case-control cohorts are good examples. Cohort studies are

less susceptible to bias and have the ability to assess causality. In these studies, the researcher identifies a potential risk factor (cause) and monitors for disease development in the follow-up. These are usually prospective studies and require a long time to be completed[38].

Considering that inhaled anesthetic toxicity is related to its byproducts from their metabolism or degradation in CO_2 absorbers, the focus of research must be the intensity and mechanisms of metabolism of these drugs. Exposure of human kidney collecting duct cells to inorganic fluoride concluded that mitochondria are the target of action of the nephrotoxicity responsible for sodium and water disturbances in these patients. Modern fluorinated anesthetics are metabolized by cytochrome P450, which is not significantly present in the human kidney. Methoxyfluorane, on the other hand, underwent significant intrarenal defluorination. Renal damage studies have shown that exposure time, i.e. the area under the curve of serum inorganic fluoride levels, is more important than isolated peak concentrations of this ion[39].

The assessment of renal tubular function should include sensitive and specific markers[40].

Contribution of Pharmacogenomics

Drug toxicity is an adverse effect of the interaction between a drug and organ systems.

DNA sequencing studies have highlighted the importance of pharmacogenomics in identifying the influence of genetic variations on drug response, through correlations between gene expression or polymorphisms and efficacy and/or adverse effect profiles of substances.

Environmental exposure affects people differently according to individual characteristics, among which are genetic factors that may augment vulnerability. There is usually a combination of genetic components and environmental issues in disease mechanisms.

Possible genotoxicity of inhaled anesthetics remains controversial. The studies published so far face technical difficulty in measuring outcomes and the bias of not knowing the subjects' pre-exposure genetic profiles.

Genetic polymorphisms influence the effect of anesthetics. The possibility of genetic predisposition for N_2O toxicity is corroborated by the case report of a patient who developed diffuse myelopathy, upper limb paresis, paraplegia and neurogenic bladder dysfunction after 2 hours of 50% N_2O anesthesia. The symptoms disappeared after folic acid and vitamin B12 use. DNA analysis showed a polymorphism of the 5,10-methylenetetrahydrofolate reductase isoform[41]. Other problems also linked to this polymorphism include thyroid cancer, ovarian and prostate cancers, congenital malformations, the incidence of Down syndrome, thrombosis and leukemia.

Thus, in addition to environmental factors, genetic polymorphism of professionals can interfere with the effects of occupational exposure to inhaled anesthetic waste.

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Exposure to Chemical Agents

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Introduction

The practice of anesthesia entails exposure to physical, biological, ergonomic and chemical hazards[1]. Fortunately, in recent years, technical advancements and guidelines have helped minimize the adverse effects of occupational exposure, although still far from eliminating them entirely[2].

Regulatory Standards

The Brazilian Ministry of Labor aims to eliminate or control occupational hazards by issuing regulatory standards (RS) about urban work. There are 32 of them and RS 32 is especially relevant to health care providers[3,4]:

- RS 1 – General provisions;
- RS 4 – Specialized services in Safety Engineering and Occupational Medicine;
- RS 5 – Internal Commission for the Prevention of Accidents;
- RS 6 – Personal protection equipment;
- RS 7 – Occupational health control program;
- RS 9 – Environmental risk prevention program;
- RS 15 – Insalubrious activities;
- RS 16 – Hazardous activities;
- RS 17 - Ergonomics;
- RS 24 – Sanitary and comfort conditions at the workplace;
- RS 26 – Safety signs at the workplace;
- RS 31 – Health and safety in confined spaces;
- RS 32 – Health and safety at the workplace in health care institutions.

Hazard Maps

According to Brazilian standards, occupational hazards can be classified in five categories, each represented by a different color (**Table 1**)[5]. Hazard maps are graphic representations of occupational risks with the intention of **a)** Gathering information to

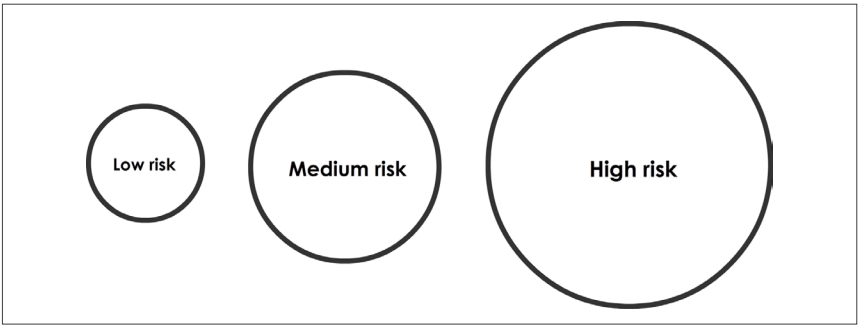
establish the Health and Safety diagnosis of the workplace, and **b)** Promoting awareness among employees and stimulating prevention strategies. They are designed by the Internal Commission for the Prevention of Accidents (ICPA) under the guidance of the company's Specialized Services in Safety Engineering and Occupational Medicine (SEOM) and should ideally include a simplified floor plan of the workplace.

Table 1 - Classification of the main occupational risks in groups, according to their nature and the standardization of corresponding colors.

Group 1 Green	Group 2 Red	Group 3 Brown	Group 4 Yellow	Group 5 Blue
Physical	Chemical	Biological	Ergonomic	Mishaps
Noise	Dust	Viruses	Physical strain	Inadequate physical setting
Vibration	Smoke	Bacteria	Weight lifting	Unprotected machines and equipment
Radiation	Mist	Protozoa	Inadequate posture	Inadequate lighting
Cold	Fog	Fungi	Excessive workload	Electricity
Heat	Gases	Parasites	Shift and nighttime work	Probability of fire and explosion
Pressure	Vapors	Bacilli	Long working hours	Inadequate storage
Humidity	Chemicals		Monotony and repeatability	Exposure to poisonous animals

Greater occupational risks must be represented by circles of increasing size (**Figure 1**).

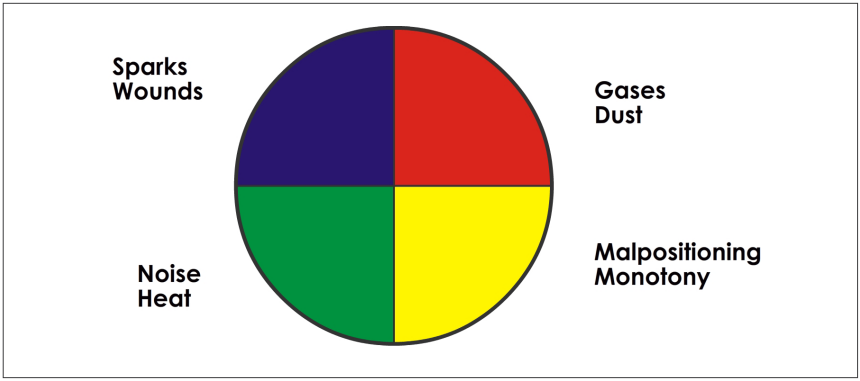
Figure 1 - Intensity of risks



Circles must be drawn or posted in the area of the floor plan where the associated risks exist. In case there are several hazards of the same category, which are harmful to the same extent (i.e. vibration, heat and noise – physical risks), a single circle can

be chosen in the appropriate color and size. When there are different risk categories in the same area, the circle can be divided in up to 5 differently colored parts, as shown in **Figure 2**. This procedure is called incident criterion[6].

Figure 2 – Incident criterion



Chemical hazards in the surgical environment may be found in solid, liquid or gaseous form and classified into[6]:

- Dust
- Smoke
- Mist
- Gas
- Vapors

These chemicals come in contact with the human body through the skin, airways or digestive system. Several factors influence their toxicity[6]:

- Concentration: the higher the concentration of an agent, the faster and more harmful its effects;
- Respiratory Index: represents the average amount of air inhaled by a professional in a workday;
- Individual sensitivity: variation in sensitivity to harmful agents between individuals;
- Toxicity
- Exposure time

Upon entering the body, these chemicals can cause a variety of toxic effects of immediate (acute) or delayed (chronic) onset, depending on the nature of and the route of exposure to the chemical. Effects can, therefore, be classified as follows[7]:

- Irritating and/or corrosive: alterations in skin and mucous membranes (cement, acids and alkali);

- Hypersensitivity reactions (nickel, chrome);
- Asphyxia: impairment of oxygen metabolism (carbon monoxide);
- Narcosis: unconsciousness (chloroform, ether, alcohol);
- Neurotoxicity: central nervous system alterations (benzene solvents in general);
- Carcinogenicity: leading to malignant tumors (benzene, formaldehyde);
- Mutagenicity: leading to mutations;
- Teratogenicity: leading to fetal malformations.

Volatile anesthetics

Even though ether, chloroform and nitrous oxide were discovered in the 19th century, the associated occupational risks were not reported until 1960[2]. Since then, the chronic effects of environmental exposure to anesthetics have been studied through epidemiological surveys, *in vitro* studies, cellular research and experimental studies. These works investigate the potential influences of waste anesthetic gas on the incidence of infertility, miscarriages, liver disease, psychomotor and behavioral changes, neurological disease and death.

An increased incidence of abortion was reported among female anesthesiologists in 1967[2]. Several studies since then have revealed the association between exposure to volatile anesthetics and spontaneous abortions, congenital abnormalities and premature births. However, most of these findings have been challenged due to methodological flaws and sources of bias such as nutritional status, obstetric history, alcohol intake, smoking and exposure to methylmethacrylate and radiation[2].

The *American Society of Anesthesiologists* (ASA) considers current evidence on the subject to be inconclusive and recommends common sense in limiting the exposure of professionals to these agents[2].

Türkan et al demonstrated that even brief exposure to waste anesthetic gas may cause headache, irritability, nausea, drowsiness, fatigue, impaired coordination and judgment and increase the risk of liver and kidney disease[8].

Volatile anesthetics seem to increase the imbalance between production of reactive oxygen species and antioxidant defense mechanisms. This condition is called oxidative stress and may damage cellular structures such as DNA, plasmatic membranes and organelles[8,9]. According to Akbar et al, even small concentrations of gas increase lipid peroxidation and production of reactive oxygen species, potentially leading to long-term damage of tissues and organs[10].

Literature shows contradictory data regarding potential mutagenic effects induced by inhaled anesthetics. There is no evidence of clinical or pathological consequences of inhaled anesthetic use in humans, even when exposure is above current limits. Only nitrous oxide has proven teratogenic in animals. The exposure of pregnant rats

to high N_2O concentrations (50% to 75%) for 24-hour periods during organogenesis and low concentrations of it (0.1%) throughout the whole pregnancy increased the incidence of visceral and skeletal abnormalities[11].

This effect is thought to originate in the inhibition of methionine synthase and consequent reduction of tetrahydrofolate in developing embryos, which would impair DNA production and result in morphological abnormalities. Even so, the reproductive effects of N_2O in rats occur only after prolonged exposure to high concentrations unlikely to be encountered in clinical practice[12].

Safety limits for inhaled anesthetic exposure have been established by some governmental organizations (**Table 2**), but some clinical situations inevitably entail increased exposure, such as inhalational induction techniques[15], ill-fitting face masks, uncuffed tracheal tubes, pediatric respiratory systems, sidestream gas analyzers, laryngeal masks, accidental disconnection of circuits, rigid bronchoscopy and others.

The *National Institute for Occupational Safety and Health* (NIOSH) states that it is impossible to define a safe level of exposure to volatile anesthetic waste and recommends the greatest possible reduction, with upper limits of 2 ppm (parts per million) in operating room air for halogenated agents and 25 ppm for nitrous oxide. When both types of anesthetics are used in combination, the limit for halogenated agents is reduced to 0.5 ppm. The maximum concentration of halothane vapor recommended by the NIOSH is many times lower than the lowest concentration recognized by the human olfactory system - few people are able to perceive concentrations of 33 ppm. Therefore, if anesthetics can be smelled in the operating room (OR), their concentration is well above recommended levels. The occupational risk extends to the post-anesthesia care unit (PACU), since patients continue to exhale volatile anesthetics for 5-8 hours after the end of anesthesia[2].

According to the *American Institute of Architects,* medical facilities must be designed to allow, on average, 15 exchanges of operating room air per hour. Air input must be through the center of the ceiling and the output must be through ducts near the ground in the lateral walls, in order to control the flow of dust and contaminants and thus maintain the surgical field sterile[13].

Recommendations for minimizing occupational exposure to volatile anesthetic agents include promotion of awareness among exposed professionals, provision of effective air exhaust systems in ORs and PACUs, adequate maintenance of anesthesia delivery machines and their waste suction devices and a monitoring system to keep records of air sampling results and liver and function screening tests of employees[14].

Table 2 - Occupational exposure levels recommended for anesthetic vapors in several countries in ppm.

	N2O	Halothane	Enflurane	Isoflurane	Sevoflurane	Desflurane
Austria		5				
Denmark	100	5	2			
France		2				
Germany	100	5	20			
United Kingdom	100	10	50	50		
Italy	100					
Norway	100	5	2	2		
Sweden	100	5	10	10		
Switzerland	100	5	10	10		
USA – NIOSH*	25	2	2	2	2	2
USA – ACGIH**	50	75				

* NIOSH: *National Institute for Occupational Safety and Health*
** ACGIH: *American conference of governmental industrial hygienists and*

Glutaraldehyde

This clear liquid with a strong odor was widely employed in hospitals for sterilization of heat-sensitive materials. Toxicity due to unprotected handling is one of its main drawbacks and is also the reason why it has been replaced with other materials. Its main toxic effects are[16]:

- Throat irritation and soreness;
- Asthma and respiratory distress symptoms;
- Nosebleed;
- Eye burning and conjunctivitis;
- Contact or atopic dermatitis rashes;
- Brown blemishes on hands;
- Urticaria;
- Headache and nausea.

Ethyl ether

Ethyl ether, also known as sulfuric ether, is a highly volatile clear liquid with a characteristic odor that is potentially flammable/explosive. Adverse effects of acute intoxication include narcosis, with an initial excitement phase followed by numbness. Vomiting, facial pallor, bradycardia and salivation can also be present. It is moderately irritating on upper airways, but aspiration to lower airways can result in chemical pneumonitis. Skin contact causes dehydration and mild local irritation, which can lead to skin fissures. Chronic exposure to high concentrations of this substance may manifest as fatigue, nausea, vomiting, headache[17].

Ethylene oxide

Due to its antibacterial effects, this clear gas has been widely employed in the sterilization of heat-sensitive medical materials. It is potentially explosive and remains impregnated on the surface of materials, which must therefore be aired after sterilization in order for ethylene oxide residue to be removed.

Symptoms of poisoning may arise several hours after exposure. Contact with skin and mucous membranes may cause irritation, skin lesions, conjunctivitis, corneal abrasion and cataracts if concentration of the substance is high. Chronic exposure may lead to allergic sensitization, nausea, vomiting, throat irritation, drowsiness, headache, weakness and seizures[18].

Latex

Latex is one of the products to which anesthesiologists are exposed most frequently. Natural or processed latex proteins constitute the most common allergens to cause reactions. There are two types of latex reactions: allergic or immunologic (type I and IV hypersensitivity reactions) and non-allergic (irritant). Type I reactions may range from localized edema to anaphylactic shock and death. Type IV reactions present as contact dermatitis. Non-allergic latex reactions, on the other hand, present as skin irritation by constant contact with latex derivatives, most commonly latex gloves[19].

Latex is conveyed by glove talc particles and can be absorbed through mucous membranes, airways and even intact skin.

Preventive measures include[20]:

- Avoiding gloves with talc and products with high antigenic load;
- Identifying latex products in the OR;
- Searching for alternative products;
- Reaffirming institutional responsibility to offer support and guidance for affected professionals.

Surgical smoke

Electric, harmonic and argon scalpels generate aerosols. Since 1920, when electrocauterization was popularized in operating rooms by the neurosurgeon Harvey Cushing, inhalation of aerosols (smoke) has become a routine part of the professional lives of surgeons, anesthesiologists and other surgical team members. The amount and content of inhaled smoke vary depending on the nature and pathology of the treated tissue, surgical technique, energy type and application time. Analyzes of this material has shown significant amounts of intact viruses, viable tumor cells and toxic chemical substances. Krones[21] et al have shown that both cutting and coagulation techniques with various types of cautery were able to produce potentially harmful smoke. Cutting at high temperatures can produce even more toxic compounds, such as acetaldehyde, formaldehyde, benzene, carbon monoxide, hydrogen cyanide and acrylamide. Some of these substances are carcinogenic

and may also precipitate ischemic heart disease. The NIOSH and the *Association of perioperative registered nurses* recommend the use of suction devices for scalpel-generated smoke, since standard surgical masks do not provide adequate protection.

Formaldehyde

Formaldehyde is commonly used in an aqueous solution to preserve tissue samples destined for histopathological examination. Brazil, ANVISA issued a resolution (RDC 37/2008) to prohibit the use of tablets containing formaldehyde or paraformaldehyde in the disinfection and sterilization of surfaces and equipment. The average concentration during exposure is 0.5 ppm and, due to its water solubility, formaldehyde is rapidly absorbed from the gastrointestinal and respiratory tracts and metabolized. Dermal absorption is minimal, but formaldehyde and its metabolites are able to penetrate the human skin and may induce contact dermatitis. Adverse effects are dose-related and range from eye, nose and throat irritation to pulmonary edema, pneumonia and even death.

The IARC - *International Agency for Research on Cancer* classified formaldehyde, from 2004, as carcinogenic and teratogenic. Nasopharyngeal neoplasms and leukemias are associated with exposure to this substance[22].

Methyl methacrylate

2-methylpropenoate (MMA) is colorless, flammable and volatile at room temperature. It is an organic monomer widely used in dentistry, neurosurgery and orthopedics as "bone cement". The main route for occupational exposure of health care providers is by inhalation. The nasal cavity and the lungs are responsible for the initial clearance of MMA by the enzyme carboxylesterase, which converts methyl methacrylate to methacrylic acid, an irritant and corrosive chemical. There organs are, therefore, the main focus of research on MMA toxicity. Pulmonary findings are emphysema, pneumonia, hemorrhage, atelectasis, edema and hyperplasia of the bronchial epithelium. An experimental study by Nai G.A. et al[23], showed potential damage in chronic inhalation of MMA vapors. Significant clinical alterations reported to date were pulmonary emphysema and liver steatosis of early detection, within five days of exposure to the agent. These data imply important occupational hazards and indicate the need for adequate fume exhaust systems while using the MMA.

Alcohol (60% to 90%)

Alcohol, in particular ethanol and isopropanol, has been used as an antimicrobial agent for many years and as carrier-solutions for water insoluble agents such as iodine and phenols. It acts by denaturing proteins, has minimal toxicity and can cause skin dryness[24].

Chlorhexidine gluconate (0.5 alcohol, 2%, 4%)

Chlorhexidine was approved for use in surgical scrubs in the mid 1970s, and as a mouthwash at 0.12% at the end of the 1980s. In surgical washes, 4% chlorhexidine solutions are fast-acting, highly effective against Gram-positive microorganisms and is less effective against Gram-negative ones. Toxicity can occur by direct con-

tact with eyes and ears of newborns. It does not cause respiratory symptoms and is slightly irritating to skin. Harmful effects are dose- and time-dependent[25].

Chemotherapy

Introduction and handling of chemotherapeutic agents in the operating room came with the advent of HIPEC (Hyperthermic Intraperitoneal Chemotherapy), which is performed after cytoreductive surgery. Cytoreductive surgery involves long periods of peritoneal and visceral resection, using high voltage electrocautery, which generates a significant amount of aerosolized particles in the operating room. The ultrafine particles and toxic substances released are associated with pulmonary dysfunction, cardiovascular alterations and increased mortality. Cytotoxic agents commonly used in this technique are: mitomycin C, cisplatin, oxaliplatin, doxorubicin, which are administered in a diluted form. Although the toxicity of these agents is well described in therapeutic dosages, long-term effects of occupational exposure to low, repeated doses remain unknown. Hence, all protective measures should be adopted.

The routes of drug exposure during HIPEC are mostly direct contact and inhalation. Professional protection measures include[26:]

- Surgical field: using impermeable and disposable drapes;
- Operating room: closed doors, restriction to circulation of people, absorbent drapes on the floor in case there is spillage;
- Personal protection: disposable long-sleeved scrub capes, impermeable shoes, ocular protection, high-protection mask (FFP3);
- Environmental measures: adequate air ventilation and exhaust systems;
- Handling residue: leak-proof containers labeled "cytotoxic agents".

Conclusion

Exposure of anesthesiologists to chemical agents can result in severe illnesses. Thankfully, the increased vigilance by government and professionals has diminished the rates of adverse events due to occupational exposure to chemical agents. Prevention strategies and identification of occupational illnesses caused by chemical agents will continue to be fundamentally based on external evaluation, since no specific and sensitive biological markers have been validated.

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Sharps injuries: Guidance for the Anesthesiologist

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Introduction

The anesthetist is exposed to many infectious blood born diseases with potentially high severity, including hepatitis B, hepatitis C and Acquired Immunodeficiency Syndrome (AIDS)[1]. Accidents at work in the hospital environment should be treated as emergencies, especially if one takes into consideration that the mortality among anesthesiologists has been demonstrated to be higher than among internists[2].

Prophylaxis

Universal precautions to be adopted in the care for all patients while handling blood, secretions and excretions and contact with mucous membranes and injured skin (**Table 1**), as well as the use of Personal Protective Equipment (PPE) (**Table 2**)[3].

Table 1 - Universal precautions for protection against occupational transmission of infections

- **Frequent hand washing.**
- **Use of Personal Protective Equipment (PPE):**

  Gloves - whenever there is a possibility of contact with blood, secretions, excretions, mucous membranes or non- intact skin areas;

  Mask, cap and goggles - while performing procedures in which there is the possibility of splattering of body fluids and blood on the mucous membranes of the mouth, nose and eyes;

  Aprons (cloak) - during procedures with the possibility of contact with biological material;

  Foot protection - in damp locations or with a significant amount of infectious material, such as surgical centers.
- **Dispose of contaminated needles immediately, no-recapping.**
- **Re-sterilization of equipment and instruments only if reuse allowed.**
- **Transport of blood contaminated material in suitable container so as to avoid leakage.**
- **Careful indication for blood transfusions.**
- **No patient contact with professionals affected by exudative dermatitis**
- **Special attention to pregnant professionals.**
- **Dispose of contaminated material immediately without re-capping needles.**

Table 2 - Basic precautions for the use of PPE

Procedure	Hand washing	Gloves	Aprons	Mask and Goggles
Examination of the patient without contact with blood, secretions, mucous membranes or non-intact skin areas	X			
Examination of patient contact with blood, secretions, mucous membranes or non-intact skin areas	X	X	*	
Sampling of blood, stool and urine examination	X	X		
Execution of dressings	X	X	*	**
Parenteral administration of drugs	X	X		**
Cannulation or cut-down for deep vein access	X	X	X	X
Airway suction and tracheal intubation	X	X	X	X
Endoscopy and bronchoscopy	X	X	X	X
Dental procedures	X	X	X	X
Procedures with the risk of splattering blood and secretions	X	X	X	X

* Use in dressings large (large surgical wounds, burns and pressure sores).
** Use if risk of blood fluid splattering or during preparation and administration of chemotherapy.

Measures after an accident involving percutaneous exposure

Care should be initiated immediately, including careful local cleaning with soap and water. Antiseptic solutions, like iodine-povidone or chlorhexidine may be useful, but no evidence exists of their superiority in relation to soap and water cleansing. In conjunctival contamination, rinsing with saline solution is indicated[3].

The local Commission for Infection Control should be consulted for a careful review of the vaccination status of the source patient and of the exposed professional, according to established norms (**Tables 3 and 4**)[3].

Table 3 - Serological Conduct for the source patient

• Anti - HIV (rapid test).
• Anti - HCV and HBsAg (waived if the contaminated person is anti - HBs positive).

Table 4 - Serological Conduct adopted for the contaminated professional

• Anti-HIV I and II (ELISA) and anti- HCV.
• HBsAg (for unvaccinated victims or for those with incomplete vaccination schedule, i.e., < 3 doses).
• Anti - HBs (for victims who received full vaccination schedule, but has not proven immunization or is anti - HBs negative)

In severe accidents prophylaxis should start to the victim and subsequently re-evaluated for changes or maintenance of treatment. If at the rapid serology test the patient is positive for HIV, the victim should start chemoprophylaxis for a period of three days, after which you should be re-evaluated by an infectologist[3].

A negative rapid test result in the source patient avoids starting chemoprophylaxis for health professionals. However, is not definitive to exclude the diagnosis of infection in the patient[3].

In accidents involving HIV patients or infected material unknown patients, the exposed professional should be followed for six months. Monitoring of the exposed professional is indicated if the source patient has been exposed to HIV in the previous three to six months, given the risk of conversion[3].

All health care professionals should be vaccinated against hepatitis B. However, with regard to hepatitis C, there is no specific effective measure to reduce the risk of infection following occupational exposure, except the prevention of percutaneous or mucous membrane exposure to blood or other biological material.

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- Part 4 -
Interdisciplinary aspects of occupational health

Addiction Among Anesthesiologists: from diagnosis to intervention

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Introduction:

Why is it important for physicians to know the Dependence Syndrome?

Doctors get sick as often as the general population[1], but mental health issues and addiction are not easily recognized, even though they are the most frequent cause of labor problems and early retirement.

These disease processes cause physicians and their families great emotional suffering and result in diminished performance, with potential consequences to their patients.

Thus, chemical dependence constitutes a disorder whose nature is *bio* (involving genetics and temperament) *psycho* (psychiatric comorbidities, expectations, coping mechanisms) *social* (family environment, peer pressure, drug availability).

Literature data on physician addiction suggest an epidemiologic profile similar to that of the general population, only with a higher prevalence of drugs whose access is facilitated by professional activity, such as benzodiazepines and opioids[2,3].

The diagnosis of dependence:

It is important that professionals know how to correctly recognize substance abuse. According to medical literature, it is an ethical duty to care for the health of colleagues, therefore it is up to physicians to alert their colleagues as soon as they notice behavioral changes that suggest mental health problems, addiction or the need for specialist consultation.

Substance dependence occurs insidiously in most cases, there is usually a progression from experimental use of a substance to a state of harmful consumption. In the early stages, biopsychological consequences already exist, but typical symptoms of dependence such as tolerance, withdrawal or other dependency elements are not evident yet.

The concept of addiction as it is currently understood was formulated more than three decades[4] ago and remains virtually unchanged in various international classification systems, as exemplified by the International Classification of Diseases (ICD-10) criteria below:

The diagnosis of substance dependence syndrome should be considered only if three or more requirements are present during the last year:

a) A strong desire or sense of compulsion to take the substance;

b) Difficulties in controlling substance-taking behavior in terms of its onset, termination and levels of use;

c) A psychological withdrawal state when substance use has ceased or has been reduced, as evidenced by: the characteristic withdrawal syndrome for the substance; or use of the same (or closely related) substance with the intention of relieving or avoiding withdrawal symptoms;

d) Evidence of tolerance, such that increased doses of the psychoactive substance are required to achieve effects originally produced by lower doses (clear examples of this are found in alcohol- and opiate-dependent individuals who may take daily doses sufficient to incapacitate or kill nontolerant users);

e) Progressive neglect of alternative pleasures or interests because of psychoactive substance use, increased amount of time necessary to obtain or take the substance or to recover from its effects;

f) Persisting with substance use despite clear evidence of overtly harmful consequences, such as harm to the liver through excessive drinking, depressive mood states consequent to periods of heavy substance use, or drug-related impairment of cognitive functioning; efforts should be made to determine that the user was actually, or could be expected to be, aware of the nature and extent of the harm.

Source: ICD-10, 2008

The mesolimbic-cortical dopaminergic system is hypothesized to be the primary pathway in the acquisition, maintenance and reinstallation of substance-seeking behaviors. It coordinates behavioral reinforcement, i.e. the strengthening of a specific behavior which makes it likely to be repeated in the future[5], and is therefore a central pathway in the pathophysiology of addiction and compulsive behaviors. Neuroadaptations in these systems favor the perpetuation of consumption in dependent individuals.

Despite growing evidence of pathological mechanisms involved in the repetitive behavior that characterizes addiction, the stigma of substance abuse still prevails and may hinder the search for care. Moreover, individuals affected by dependence syndrome or mental illnesses suffer from self-stigma as well[6].

Besides strong stigma, there is a conspiracy of silence regarding the issue of alcohol and drug abuse among physicians, i.e. no one wants to raise the question for fear of harming colleagues affected by the condition. The problem is much more complex

than individual mechanisms of denial[7]. This attitude delays the search for effective and empathetic treatment. The criteria for alcohol dependence and drugs include continued use despite awareness of harmful consequences, which implies that a non-interventionist stance will only maintain or worsen consumption patterns. In order to be effective, however, therapeutic intervention must not be punitive[7].

The problem of addiction among anesthesiologists

Some occupational hazards inherent to the practice of anesthesiology are well documented, like anesthetic gas toxicity, needlestick injury, exposure to ionizing radiation and latex allergy. Recently, a French study highlighted two new increasingly recognized risks: burnout syndrome and drug addiction[8].

There is consensus in the international literature about the fact that anesthesiologists are overrepresented in the group of physicians seeking treatment for addiction[9-14]. Drug addiction has, in fact, been described as the most prominent safety and health issue among anesthesiologists[15].

Studies have reported lower consumption of illicit substances such as marijuana and cocaine among anesthesiologists[16]. Although alcohol is not the issue that stands out most in this professional category, it is the most commonly used drug[2,17].

Experimenting drugs can happen especially as attempted self-medication for:

1. "Insomnia" (often poor sleep hygiene or sleep deprivation or "need to sleep", i.e., seeking performance improvement)
2. The continuum of burnout syndrome, depression and anxiety.
3. Pain (headache, back pain, muscle tension) – certainly less intense than would be justifiable for using intravenous medications.

Another hypothesis is "curiosity", since mechanisms similar to those of the general population may also occur among health care professionals, especially among those who began consumption during adolescence. Other mechanisms cited in the literature include[18-20]:

- Possible environmental exposure to drugs (enough to generate receptor sensitization, as occurs with passive smoking)[21,22];
- Curiosity due to having witnessed drug effects on patients and heard their descriptions;
- Technical knowledge about dose management and precise application of intravenous medications – feeling of "knowing what one is doing"
- Loss of taboo against blood, syringes and injections;
- The stressful nature of the profession, which has been considered a risk factor. Burnout syndrome has been observed in as much as 40% of surveyed doctors, with higher rates among young residents[23].

Environmental Exposure to Volatile Drugs

Exposure to volatilized substances in the operating room has been a concern in the medical literature for forty years[24,25].

Fentanyl and sufentanil are highly potent drugs, 80-800 times stronger than morphine[26]. Exposure to aerossol particles of anesthetic drugs like Propofol and Fentanyl has been theorized as a risk factor for substance dependence among anesthesiologists. One study found small concentrations of these substances in operating room air, especially in the air exhaled by the patient, i.e. in the area where anesthesiologists work for hours over the years. This hypothesis might provide an explanation for the high rates of drug experimentation and addiction among these physicians, even when compared to other specialties with easy access to opioids, such as oncology[26,27]. It can also alert to higher risks of relapse, through the phenomenon of neurobiological sensitization[21].

Although medical literature reveals that about 70% of anesthesiologists seeking specialized treatment are dependent on fentanyl, anesthesiologists use various classes of drugs. The medications most frequently taken are opioids, followed by benzodiazepines, illicit drugs, propofol and ketamine[28].

An American study compared cause-specific mortality risks of anesthesiologists with that of internal medicine practitioners between 1979 and 1995 and reported relative risks of approximately 2 for death by suicide and nearly 3 for drug-related death. Moreover, deaths related to Hepatitis C and HIV were also significantly higher among anesthesiologists[29]. These differences between the two specialties are greatest in the first five years after medical school graduation, which corroborates other findings of increased vulnerability during this period.

Suicide is highly prevalent among anesthesiologists when compared to other medical specialties[30]. This mortality profile substantiates concerns about the occupational health of anesthetists and the higher prevalence of drug addiction in this population. This issue started to gain attention in the medical literature forty years ago[31].

Since then, interests have grown over the mental health of anesthesiologists, especially regarding addiction and suicide. A British study evaluated 304 departments of anesthesiology and noted that alcohol and drug misuse are common and that most colleagues do not feel comfortable or able to deal with these situations[13].

Anesthesiology Residency and Mental Health

Medical residency was developed in the USA in 1889 and has since been adopted in most medical schools in the world as the gold standard of training. In Brazil, it was established in 1944-45. But although this is considered one of the most sophisticated educational systems for professional training, it is also a very stressful period in a

physician's life. Several factors combine, usually in a synergistic manner, for the difficulties residents face[32]:

- Duplicity of functions (student and practitioner)
- High workload and sleep deprivation
- Institutional deficiencies and constraints
- Adaptation to new situations
- Psychological violence
- Discrimination / Sexual Harassment
- Fear of making mistakes
- Dealing with critically ill, demanding and/or non-compliant patients

Thus, residency has often been associated with sadness, anger, emotional blunting, development of ironic black humor and cynicism, alcohol and drug abuse and suicidal ideation. Physicians' quality of life is significantly affected, and the first year of residence is more stressful than the second, which in turn is more stressful than the third[33].

Residents and program directors have contrasting opinions about workload reduction. Both groups agree that residents' quality of life is improved by reducing the workload[34-36], but it is still unclear whether there are enhancements in patient safety and quality of training.

Drug addiction among anesthesiologists can occur as early as during residency, according to literature data. A survey of 133 residency programs made in 1997, with a 93% response rate, showed rates of chemical dependence of 1.6% among residents and 1.0% among supervisors[37].

An estimated 0.7% of residents a year will develop addiction. The prevalence of opioid dependence throughout the 3 years of the residency program has been estimated in 1.3%[38] to 2.1%[39].

The perception of anesthesiology residents is that they receive little information about alcohol and drugs and that institutional drug-control policies are flawed. Some residents also witness supervisors using these substances, a fact that impairs their teaching[12]. Similarly, an Australian study found that only 7% of residents received any training about the risks of dependence on controlled substances[38].

What happens to the addicted anesthetist?

(Prognosis Studies)

The first American study to report outcomes of drug-dependence in anesthetists noted that, out of 134 cases reported between 1970 and 1980, including residents and instructors, the drugs most often abused were fentanyl and meperidine. Thirty professionals had died of overdose and 71 professionals had been able to return to the profession[40]. This study discussed the great risk of resuming anesthetic practice.

However, criticisms to it were based on its being retrospective, which may have favored memory bias and made bad outcomes more likely to be reported.

A study that evaluated the first 1000 cases referred to the Impaired Physicians Program in Georgia noted that doctors are a population at risk for addiction and that, among these, anesthetists are clearly overrepresented[10]. Moreover, compared to other doctors, anesthesiologists were more likely to abuse drugs than alcohol, to use opioids and to administer drugs mainly intravenously[11]. The authors emphasize the need for more awareness about the issue, as well as early detection and treatment aiming for rehabilitation.

Another investigation about the treatment outcomes of anesthesiology residents analyzed data from 180 trainees, 26 of which died of overdose[41]. 113 out of the 180 residents were allowed reenter anesthesiology training. Those previously dependent on opioids (79 cases) had a success rate of 34% (27 cases). There were 14 deaths from suicide or overdose among residents who were allowed reentry into the profession (17%). Among trainees who abused other drugs (non-opioids), the success rate in resuming professional activity was 70% (16 of 23 cases). The authors therefore suggest that anesthesiologists who have faced opioid-dependence be relocated to another medical specialty.

Based on studies reporting poor results in attempts to resume anesthesiology practice by residents who abused opioids, an article suggested, as a standard procedure, the idea "One strike, you're out"[14], i.e., "used injection drugs once, you're out of anesthesiology." This has motivated great debate in the American Society of Anesthesiology, since other studies have reported better outcomes regarding reentry. Another literature review supports the theory that it is best not to resume anesthesiology practice after a course of dependence, even after treatment for addiction[42]. However, these authors comment that some smaller studies found better outcomes, often at the expense of more systematic monitoring programs, and possibly using the long-acting opioid antagonist naltrexone.

Literature reveals that anesthesiologists who continue practicing anesthesiology have an increased risk of relapse compared to the ones who changed specialty[43]. Analysis of 292 physicians treated at a specialized center in Washington showed that, after successful initial treatment for detoxification, factors related to high risk of relapse were: a family history of addiction (nearly triples the risk of relapse), psychiatric comorbidity alone and opioid dependence in the presence of psychiatric comorbidity (nearly six times greater risk of relapse). When all three factors were present, the risk of relapse was almost 14 times higher[43].

It is therefore suggested that the decision to reentry the practice of anesthesiology be made on a case-by-case basis, considering local variables as the institution's capacity to absorb a doctor in a reentry program, the presence of family history and psychiatric comorbidity as well as compliance with a specialized care program involving continued monitoring[42].

One study noted slightly better results regarding recoverability and even return to professional activity of anesthetists with greater security than previously reported[44].

Analysis of 16 U.S. programs for alcohol- and drug-dependent physicians showed that anesthetists, when engaged in the treatment and closely monitored, had similar rates of successful resumption of work as other specialists, even when the abused drugs were opioids, contradicting previous publications[45]. There was no difference in terms of relapse rate, mortality or professional problems when compared to other medical specialties.

Reentry into professional practice by anesthesiologists who abused opioids and other injectable drugs remains highly controversial, especially because of difficulties in the follow-up of identified cases due to high rates of geographical changes[46,47].

How to deal with colleagues facing drug abuse issues

Many physicians experience situations when there is robust evidence of substance abuse by colleagues.

Although there are no pathognomonic signs, some changes may be suggestive of drug problems, especially when many of these coexist, such as sudden and unpredictable behavioral changes, refusal of meals and snack breaks, desire to work alone, willingness to work extra time, frequent breakage of vials of anesthetic, frequent trips to the bathroom or on-call room[48]. Some studies suggest that statistical programs that are sensitive to changes in prescribing patterns can help detect potential abusers[49,50].

A physician who is addicted to opioids or other anesthetic drugs may seek extra working time in order to be close to the source of the substance abused. This, combined with multiple jobs, little contact with the family and the usually independent way of working, often complicates the diagnosis of dependence.

Hence the need for an approach that is at the same time firm and compassionate. Awareness of labor laws and routes of referral to treatment, which differ greatly from region to region, is essential. Regardless of differences in laws, some components of appropriate approach involve:

- Showing interest in listening to the problems the physician want to express;
- Avoiding confrontation and encouraging him to seek specialized evaluation;
- Referring him to professionals trained in dependence treatment;
- Trying to reassure him that, once treated, his job and wages will be maintained, as well as anonymity. If the affected doctor cannot resume work as an anesthesiologist, the institution should ideally assist him in the transition to another specialty;
- Requesting that the physician responsible for the colleague's treatment provide regular reports regarding compliance with treatment;

- In certain instances, according to local policies of confidentiality and involvement of medical practice regulators, samples of hair for drug-testing are required in order to allow return to activity in the operating suite. This seems to be the most reliable way of monitoring cessation of substance abuse.

Although is it not the drug that most motivates treatment-seeking, alcohol is probably the one that most frequently causes problems for anesthesiologists.

The majority of anesthesiologists treated for substance abuse have a "dependent profile dependent". Many of them show type A behavior: competitive, proactive, extremely dedicated to work and, often, devoid of obvious signs of psychopathology. Thus, strategies that focus on all anesthesiologists (universal prevention) may make more sense and deliver better results than selective prevention strategies focused only on more vulnerable groups.

It is recommendable that programs aimed at the health of anesthesiologists have a wide range of action and don't focus exclusively on substance abuse, which could even impair the dissemination strategy of the campaign. Programs aiming for physician health and quality of life may be more welcome and suffer less resistance to implementation and maintenance.

What works and how treatment should be

Despite being a chronic disease, there is a tendency on the part of most physicians to perceive addiction as an acute condition, such as a fracture or pneumococcal pneumonia, so that the treatment is thought of according to that viewpoint, and detoxification is considered the ideal treatment. Relapse is seen as a failure of treatment rather than a condition inherent to the disease itself [51].

Neurotransmission pathways remain altered for long periods after cessation of drug use and manifest again quickly after resumption, which leads to the phenomenon of relapse and reinstallation of dependence syndrome.

There is no international consensus on how the treatment of chemically dependent anesthesiologists should be, but some strategies have been formulated in the dedicated literature.

In the first place, it is important that employers have a definite and compassionate approach with a colleague who is facing drug-related problems. It is also clear that treatment must be made by staff experienced in the care of addicted physicians[52].

It is not usually necessary for the affected physician to be suspended from his job as long as he's being treated, although an initial period of detachment is essential in cases of dependence on drugs such as opioids and propofol.

Data from a long follow-up program suggest that the initial detachment period for opioid-dependent residents should last at least twelve months in order for the physician to focus solely on recovery[53]. After this, there should be a gradual return to prac-

tice, starting with activities involving less exposure to drugs and with close monitoring. The treatment of associated psychiatric comorbidities is essential[54], since they are important risk factors for relapse[43].

An important guide produced by NIDA (National Institute on Drug Abuse), "Principles of effective treatment of addiction", enumerates useful tools in clinical management whose validity has been supported by meta-analyses[55]. It is worth noting that treatment is usually long and hospitalization may be necessary, in addition to behavioral/counseling therapies. Treatment of psychiatric comorbidities, present in about 50% of these individuals, is also essential.

Management of withdrawal:

Although withdrawal syndrome results in great physical and mental suffering, it is rarely life-threatening. When opioid substitution is necessary, the drug most recommended by medical literature is methadone. Initial methadone dosing ranges from 20 to 120 mg per day but, in most cases, the dose lies between 30 and 60 mg per day.

The attending physician must provide a phone number for quick contact in case the recovering professional needs support during difficulties.

The affected anesthesiologist should be detached from any medical activity for an initial period.

Hospitalization is not necessary as long as the anesthesiologist is adherent to treatment and does not present severe comorbidities. It is usually costly and gives rise to a feeling that "now the problem is solved", in addition to stigmatizing the patient.

The family should monitor compliance with treatment and contribute to the various treatment approaches: engaging the patient's family in treatment plays a key role in its maintenance of over the years.

Methadone administration should be restricted to the period of transition from withdrawal to complete abstinence and, after at least two weeks without methadone, it is recommended to introduce the use of an opioid antagonist (naltrexone).

Relapse Prevention Strategies: Using Naltrexone

Naltrexone is an opioid antagonist that has been used to reduce the incidence of relapse and to aid in the "behavioral extinction" of opioid abuse. It has also been used safely and with little side effects in the treatment of alcoholism[56].

A study compared the relapse frequency of 11 anesthesiologists who underwent mandatory naltrexone treatment with that of 11 anesthesiologists who didn't receive this drug. In the group that didn't receive naltrexone treatment, 8 out of 11 professionals relapsed and only one could resume anesthetic practice. On the other hand, only one naltrexone-treated anesthesiologist relapsed, and 9 of the 11 doctors in this group were successful in returning to anesthesiology[57].

A few considerations must be made:

- Naltrexone must not be administered on the first days of abstinence (or during the first two weeks of methadone removal) due to the risk of "super withdrawal syndrome";
- Patients must sign an informed consent for using this medication. The suspension of its use followed by opioid relapse greatly increases overdose risks, due to hypersensitization of receptors;
- The family should be engaged in treatment and help the patient take his medications. Ideally, the family should retain medications and supervise its administration, and alternatively, medications can be taken upon arrival at the workplace. Naltrexone can be administered twice a week, after an adjustment period of three tablets twice a week.

Literature has shown superior results with deposit naltrexone once a month than with oral naltrexone, although this strategy has not yet been documented for opioid-dependent physicians[58-60]. The key difference is greater adherence to this form of administration (one decision a month, versus 30 decisions a month).

Return to Anesthesiology practice:

There is no consensus on how reentry of anesthesiologists into professional activity should be. It is recommended that there be collaboration of all stakeholders: department chairmen, family, affected physician and attending professionals - psychiatrist and clinical staff. The physician must sign an informed consent form, provide samples of hair, avoid working excessively, at night or during weekends. A period of at least a year away from the operating suite is also recommendable, in order for the patient to ponder his professional choice[54].

Many environmental cues to relapse in operating suite populations (not only anesthesiologists) have not been well described yet, but probably involve olfactory stimuli such as alcohol swabs and electrocautery smoke, environmental stimuli (the actual operating suite) and interpersonal ones[61]. These elements contribute to higher rates of relapse among anesthesiologists, since there is no way of avoiding those factors upon returning to professional activity.

Relocating to another specialty has shown good results. However, this type of procedure entails collaboration of the physician. Legal, financial and family support are essential during the recovery process, which can often require retraining in another area of medical practice.

Treatment centers for doctors:

Centers specialized in dependence treatment for physicians take into account various financial, legal and cultural aspects. It is recommended that reception be as brief as possible, that there be strict confidentiality policies and that these institutions work independently of medical practice regulatory instances.

Providing guidance to family members and colleagues of the affected physician is a key issue. Making his colleagues aware that he needs help and financial assistance if he needs to stop working to get treatment is very important. Guaranteed job and/or compensation to colleagues who commit to treatment is essential, because acting otherwise can prevent future cases from seeking treatment or make colleagues uncomfortable by recommending that an anesthesiologist with problems seek help.

Advertising of specialized care services should be made for doctors exclusively in order to avoid alarmism in the general population, which could lead to resistance by physicians themselves .

Approaches should be wide-focused and multiprofessional, targeting not only chemical dependence, but also mental and occupational health issues. Experimentation of anesthetic drugs may be prevented by early identification of mental health disruptions[62].

Support services to physicians should be well publicized and have the support of medical regulatory institutions. Such services shall rely on specific training to deal with the peculiarities of chemical dependency among physicians, especially in the case of use of injectable substances, in addition to general knowledge regarding addiction. The establishment of a telephone hotline is a possible strategy to facilitate access.

Screening tests:

Hair examinations have been reported as the best alternative, since they are difficult to tamper and cover a broader time period[48]. Saliva samples are pending validation[63]. In opioid-dependent individuals (general non-medical population), random screening tests and observance of behavioral progress are related to better outcomes[64].

Mutual help groups:

Groups of mutual help have been highlighted as an important strategy for dealing with addiction among physicians. In many countries, there are groups specific for physicians or for all health care professionals. Such groups operate independently to medical care centers.

Prevention

Efficient approach strategies involve prevention (through improving working conditions), promotion of awareness of these diseases by medical practitioners and efforts for early detection[8].

Effective measures to prevent the consumption of alcohol and drugs among anesthetists have not yet been established. It appears that important strategies include changing the culture of self-medication, since this may be a risk factor for drug dependence[3]. Ideally, every doctor should have their trusted physician.

Better drug dispensation control and monitoring of anesthetic records have been underlined as potentially useful strategies in dealing with prescription drug diver-

sion[65]. Despite greater control in various anesthesiology programs, it has not been possible to correlate those strategies with lower rates of abuse[66]. Still, better control of anesthetic dispensation is related to higher rates of early detection of abuse[67-68].

Training anesthesiology residents to address issues of professional stress, pain, fatigue, work overload, burnout syndrome, anxiety and depression, as well as to search for social support and workload reduction have been reported as effective strategies to improve quality of life[69].

Web portals for training and education such as http://www.ephysician.com can be useful in increasing awareness about mental health issues, quality of life and dependencies.

Given that medical residency is the period of greatest vulnerability in physicians' lives, the provision of easily accessible and confidential resident care centers can be fundamental for stress management during this period, by offering residents emotional support, psychotherapy, psychopharmacological treatment, and support groups[1,70]. Some studies support workload reduction and the institution of post-shift time off, since cognition can be impaired by sleep deprivation during this period[71].

Multimodal prevention measures have been proposed that include random testing and mandatory continued education modules for all staff in the anesthesia department, as well as better dispensing control of potentially addictive substances[15].

Random urine tests for all anesthesiology residents were suggested based on the premise that the specialty should be entirely free of any psychoactive substance use, with respect to patient rights[72]. Those strategies, however, have been highly questioned both due to the difficulty of test implementation and the ethical and operational costs[73]. There is also the possibility of adulteration of the results[74]. Physicians divert prescription drugs by various mechanisms, which makes monitoring a complex process[75].

Inhalants:

Albeit less studied as abuse substances, dependence on inhaled anesthetics has been associated in recent studies with significant mortality rates, as well as low success rates upon reentry into professional practice[76].

Ketamine :

The use of ketamine has been reported between anesthetists, but at a lower frequency [48,77].

Propofol:

The first reports of abuse of propofol appeared in the medical literature nearly twenty years ago[78]. It is worth noting that propofol, in sub-anesthetic doses, can originate gratification and promote reinforcement (increasing the chance of repeating the event in the future), so the study of its dependence potential must be better understood[79].

There is wide perception that propofol addiction is increasing: a survey evidenced that, in 10-year period, approximately 18% of American residency programs had at least one reported case of abuse of this drug[80]. Mortality among propofol-dependent anesthesiology practitioners was 28%, most which were residents. Likelihood of abuse There showed correlation with lack of drug-dispensation control by the hospital pharmacy (p 0.048). The increase in ketamine and propofol abuse among anesthesiologists can be explained by the easier access when compared to opioids[28].

A study of 16 propofol-dependent residents showed that six of them died, and out of the remaining ten, three abandoned medicine, five changed medical specialty and only two remained in anesthesiology[80].

An American case series of propofol addiction showed rapidly progressive and descending clinical courses. It also discussed the increased prevalence of propofol abuse in recent years, according to the perception of professionals specialized in caring for addicted physicians. The first symptom of propofol abuse was death in 28% of cases[81].

Final Thoughts

Besides being more prevalent than in other medical specialties, substance dependence among anesthesiologists involves factors that set it apart from other forms of illness - the person who suffers from this condition usually cannot seek help for fear of losing his profession[39], and requires very compassionate and firm post-treatment care.

Unlike other doctors, the search for treatment is mainly by self-demand or indication of colleagues or heads of department[3]. This suggests that the problem can be barely visible by the physician's family, hence the need for colleagues and the physician himself to be aware of mental health issues and consumption patterns of any psychoactive substance. This approach has the potential to protect the affected physician as well as his patients, and should be seen not only as a caretaking gesture, but also as standard ethical conduct.

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Ethical and legal aspects of medical malpractice

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Introduction

Anesthesiologists are exposed to several occupational risks as a consequence of the working environment and their professional activities. One can cite physical damage, like inhalational anesthetic-induced toxicity, exposition to infected blood and secretions, ionizing radiation. Other risks are related to psychological damage, including drug addition and burnout syndrome, which are the focus of this chapter.

Anesthesiology in particular is considered an extremely stressing specialty presenting several occupational hazard factors, like inadequate working conditions; long working hours, frequently associated with sleep deprivation; overwhelming responsibility; low income; and the need for constant updating efforts. As a consequence of these factors, anesthesiologists are at risk of developing several psychological morbidities.

The problem from the psychological and physical standpoints

The commonest problems are stress, crises of anxiety, humor changes, and the consequences of the consumption of psychoactive substances. Suicidal behavior, somatization of depressive states (the development of physical manifestations of the disease that causes early or permanent sick leaves from work), and burnout syndrome may also occur.

Burnout syndrome is a work-related psychological nosology. It is a type of prolonged response to chronic emotional and interpersonal stressors at work. Clinical manifestations are usually nonspecific and include fatigue, eating and sleep disorders, headaches and emotional instability. It may evolve to emotional exhaustion, with confused mental state, low personal accomplishment, professional frustration and ultimately depersonalization. If diagnosed, temporary leave from work, psychiatric treatment and rehabilitation are required.

Drug addiction (biochemical addiction) is defined as the abuse and repeated use of a substance, which leads to a clinical condition characterized by significant adverse effects. Among them, we highlight withdrawal symptoms, the need for progressively larger amounts of the drug, which entails increasing demand for the drug and fruitless attempts for self-control. Numerous factors may induce professionals to start using addicting substances: psychological aggression as a result of daily activities, ease of obtaining psychoactive drugs, desire to experiment, genetic predisposition, low self-esteem and others associated with pre-existing psychiatric disorders. The most prevalent substances are alcohol, opioids (fentanyl, sufentanil,

pethidine and morphine), cannabis, cocaine, benzodiazepines and propofol (in sub-anesthetic doses).

In drug addiction, there are different ways to establish dependency. One is psychological, in which the body has the need to use the substance for a sense of well being and relief from everyday stress. It is generally characterized by a repetitive search for sensations the addict used to experiment during the early days of drug abuse, manifested by brain effects such as reduction of symptoms of anxiety, feelings of euphoria, pleasant mood swings, altered perception of senses and sense of increased physical and mental capacities.

Another form is physical dependence in which the body adapts to certain substance. Thus, when the use of the substance is interrupted, the user undergoes physical symptoms and signals and enters a state of anxiety. Factors such as genetic profile, physical constitution of the user and usage pattern are variables that can influence the time of drug abuse, which is also an aspect of physical dependence.

When the body adapts to a substance that is if used regularly and in large quantities, mechanisms of defense are created. When the use of the drug is interrupted, the user presents withdrawal symptoms. Once detected the state of drug addiction, which is often difficult to be identified, the professional should be removed from his/her clinical activities and referred to psychiatric treatment. It is noteworthy that treatment is difficult to control, as well as the reintegration of the professional to the specialty.

A study about chemical dependence among anesthesiologists

The Research Unit in Alcohol and Drugs (UNIAD, from the Portuguese Unidade de Pesquisa em Álcool e Drogas), from the Escola Paulista de Medicina, performed a study of the clinical and demographic profile of a sample of physicians undertaking treatment for substance abuse. This study collected data from 198 doctors under ambulatory treatment for substance abuse through a form. The form included psychiatric comorbidities and the consequences of drug addiction.

The majority of participants were male (87,8%), married (60,1%), of an average age of 39,4 years (standard deviation 10,7 years). Sixty-six percent of them had already been hospitalized for alcohol/drug abuse. Seventy-nine percent had been through medical residency programs and the most frequent specialties were internal medicine, anesthesiology and general surgery.

Psychiatric comorbidities of the axis I of DSM-IV were diagnosed in 27,7% of the sample , while diseases of the axis II of the same manual were present in 6%. The substances most frequently abused were a combination of alcohol and drugs (36,8%), followed by alcohol alone (34,3%) and drugs (28,3%). There was an average 3,7-year interval between identification of substance abuse and the reach for treatment. Thirty percent of patients looked for treatment voluntarily.

Regarding social and medico legal issues associated with drug addiction, the study showed a prevalence of unemployment during the previous year in one third of the sample, divorce in 52%, involvement in traffic accidents in 42%, legal issues in 19%, professional issues in 84,8% and issues with local medical practice regulatory boards in 8,5% of the surveyed physicians.

1. Increasing knowledge about chemical dependence and fostering awareness of it during medical school can increase rates of early diagnosis as well as spontaneous reach for treatment. Physicians' outlook on substance abuse, combined with insufficient information, leads to the common impression of hopelessness associated with untreatable diseases. Doctors fear stigma, lack of confidentiality, loss of reputation and unemployment. The result is a "silence conspiracy": family members and colleagues tend to deny or choose not to approach the issue, fearing its consequences. Thus, diagnosis is often sudden and late.

2. Educational and healthcare measures must be undertaken in order to reduce self-medication, which can delay diagnosis and treatment.

3. Training healthcare teams to recognize, advise and confront addicted professionals is essential. Advising and referring there individuals for appropriate treatment is an ethical duty - intervention in these cases can save lives, both of the addicted physician and that of his patients. Although the initial reaction may be anger, it often turns into profound gratitude at the end of a successful treatment course.

4. Specific services for the treatment of addicted physicians must be implemented, which contributes to screening for new cases and enhances compliance with the treatment while protecting doctors and the general public. According to the English Medical Association, there must be specific services for addicted physicians, since traditional models are inefficient. Three components are essential for the effectiveness of these services: firstly, treatment entry must be simple, quick and well-publicized. Secondly, care is better when provided by other physicians, and lastly, long-term support must be offered, including monitoring and supervision, focusing on the prevention of relapse. The existence of specialized services is an additional line of reasoning to convince addicted professionals to look for treatment.

5. Reentry into medical practice, i.e., changing to another medical specialty due to substance abuse happened in 4,5% of the sample in the UNIAD study. This subject warrants further investigation, since it allows doctors to change from a high-risk specialty to one associated with lesser risks of substance abuse, for instance, anesthesiology to family medicine.

6. The rate of non-medical legal issues (19%) shows that these individuals need legal support rather frequently, which shall not be neglected in care programs for addicted physicians.

7. Follow-up studies are necessary to evaluate the long-term effects of treatment. The study of physicians who deny treatment may help build knowledge about

the natural history and clinical course of chemical dependence among doctors. Well-designed prevalence studies are also warranted.

8. Screening tests for substance abuse (urine and hair samples) may be useful in enhancing the reliability of self-reporting as well as ameliorating the performance of affected physicians and offering legal protection from unfounded accusations.

Chemical Dependence: facing the problem

Regarding precautionary suspension of professional practice and the treatment of physicians with psychic disorders, the Regional Council of Medicine of the state of São Paulo (CREMESP) innovated in adopting permanently the successful experience performed at the beginning of the decade. In May 6th 2002, the Support System for Physicians with Chemical Dependence was consolidated.

This pioneer initiative in Brazil resulted from an alliance between the regional council of medicine and the UNIAD with the goal of facilitating access to treatment, preserving physicians' health and their right to practice Medicine.

This project originated in the need to approach drug abuse in a mature, conscientious and active manner. Addicted physicians need the help of their colleagues, since they may distance themselves from friends and family.

There is no single recipe for the approach of such individuals. Personal and contextual characteristics must be taken into account. However, experience shows the importance of decisive and empathetic action by offering alternatives while prioritizing attitude changes.

Access to the support system occurs initially via a call center. After that, an in-person approach is attempted within the shortest possible time interval from the initial call, ideally up to 24 to 48 hours. In this interview, diagnostic plans and treatment referrals are made.

When psychological and/or psychiatric support are indicated, if the patient so wishes, the first sessions (usually the first four sessions) are offered by UNIAD for free. After this stage, the affected physician will be referred to a cast of psychiatrists in the state with whom they will discuss the need for psychotherapy, withdrawal from professional activity and occupational therapy.

With the help of social services, CREMESP develops welcoming strategies for professionals under administrative inquiries whose illness is severe enough to warrant withdrawal from medical practice. One of these strategies is referral to the above mentioned support system.

A fundamental principle in this process lies in the fact that professionals engaged in these activities do it voluntarily. Since the majority of illnesses are related to chemical dependence, psychiatrists who have a background in dealing with such issues are preferred.

One of the challenges for the consolidation of this support system is obtaining better coverage inland; for that reason, psychiatrists are needed in smaller cities further away from the capital of the state. In many cases, physicians who work with UNIAD/CREMESP stay on performing follow-up or clinical supervision activities. Those interested in joining the initiative can send their curricula to the medical education institutions which are part of the program.

Ethical and legal aspects

Medical malpractice poses the duty to answer for the consequences of professional activity. According to law, physicians can be penalized for breaching others' rights, either by individual or collective actions.

In those cases, there will be an administrative or legal inquiry. On ethical terms, the motive of violation is of administrative concern and responsibility for it belongs exclusively to the professional who performed it. Anesthesiologists' ethics commandments are conditioned to the Medical Ethical Code, as well as to the norms designed and published by the Regional and Federal Councils of Medicine.

On the civil jurisdiction, the motive of violation is of private concern and the goal is to enable someone whose rights were violated to be compensated for the damage inflicted. Civil action is conditioned to the Civil Code as well as the Consumer's Protection Code.

On the penal jurisdiction, the motive of violation is of collective concern and raises a trial for elucidation of the fact and its autorship. Upon confirmation, a sanction will be made. The penal action is conditioned to the Penal Code.

The ethical aspects

In Brazil, the Councils of Medicine were created by federal law nº 3.268 from 30/08/1957, signed by President Juscelino Kubitschek. The decree nº 44.045 from 19/07/1958 approved the authority of the Federal Council of Medicine (CFM) and that of the Regional Councils, to which this federal law applies.

The Medical Ethical Code was last updated in 2009 under the norm nº 1.931 from the Federal Council of Medicine. This code includes the norms to be respected by physicians in medical practice: 25 fundamental principles, 10 norms related to professional rights and 118 norms regarding duties to be followed by doctors and whose transgression warrants penal sanctions.

Anesthesiologists, due to the peculiarities of their specialty, are also subject to the norms and resolutions of the CFM. Those rules aim to protect the lives of patients undergoing anesthetics acts in or out of the hospital environment.

CFM norms can be altered and improved in consonance with the evolution of medicine or alterations in law and society. The Technical Committee of Anesthesiology from the FCM reevaluates proposals of alterations in norms and follows up on the viability of these changes. It also issues appraisals of specific qualms.

One of the most important regulations for technical and ethical aspects of the practice of anesthesiology is norm 1.802/2006 from the FCM. Given the importance of this document, it is available in full at the end of this chapter.

Another important norm, number 1.990/2012, which regulates administrative inquiries about the existence of illnesses that disable partially or completely a physician for professional practice. This norm addresses precautionary suspensions of professional practice, which enables physicians affected by psychic illnesses (for instance burnout syndrome or chemical dependence, among others) to be withdrawn from medical practice while being treated. This helps prevent professional malpractice.

Civil responsibility

Civil responsibility inquiries aim for integral compensation of any damage suffered by the victim. It can be ascribed to the causative agent in one of two manners, depending on the assumptions made. From a subjective point of view, it is necessary to determine whether the act was intentional or unintentional in order to justify the right to compensation. From an objective point of view, this characteristic is not taken into account.

Inculpation occurs when the agent ignored established caution standards, acted in a heedless manner which can be classified as imprudent, negligent or inexperience. Imprudence consists in recklessness, lack of caution in performing a given task. Negligence consists in omission and inexperience is characterized by lack of expertise. Inculpation occurs when the author acts deliberately, that is, he performed a given act out of his own free will.

In both cases (subjective and objective responsibility), damage and motive must be present. Therefore, in civil responsibility inquiries, a distinction must be made between objective and subjective based on culpability, which is a prerequisite for obligatory compensation. This element is present when the matter is subjective responsibility, whereas it is discarded when the matter is objective responsibility.

Medical liability is regulated by Art. 14, § 4 of Brazilian law 8.078/1990, which established the Consumer's Protection Code. According to this law, the liability of any self-employed professional will be evaluated according to the existence of culpability, through subjective responsibility.

Civil responsibility, once established and adjudicated, pressuposes settling of damage. Quantifying material damage does not entail great difficulty. Indenization for material damage is rather predictable, since it refers to existent and measurable patrimony.

Besides, in case of physical damage, a refund can be offered to cover expenses with medications, hospital stay and further surgery. In case the patient cannot work for a certain period, his daily income must also be refunded. When there is permanent damage, the income that the patient would receive, be it from wages or any other

source of income, should also be included. When death occurs, financial compensation must include 2/3 of the victim's income, to be paid to his family.

Penal Responsibility

Physicians and especially anesthesiologists cannot offer patients certainty of success. Several extraneous factors can change the course of facts, for instance, people react differently to the same treatment. The same procedure that results in recovery for one patient can lead to adverse effects for another.

In order for criminal as well as civil accountability of anesthesiologist to occur, he must commit an act specified in law as a crime. Intention must be proven, that is, the perpetrator must have desired the result of his action or accepted the risk of causing it. Professionals may also be ascribed unintentional culpability when damage results from imprudence, negligence or inexperience (Art. 18, II of the Penal Code).

Another characteristic of concern is the existence of an outcome (with some exceptions) and a causal relationship that links conduct to results. It must be ascertained that the act was, in fact, illicit, and a breach of law, since there are conditions in which the Penal Code itself established the exclusion of wrongfulness. Justified self-defense, compliance with legal duty and acts performed in the name of law are typical examples of this.

Usually, penal liability of anesthesiologists occurs through unintentional acts – imprudence, negligence or inexperience. Imprudence happens when a physician makes rushed, reckless decisions. Negligence is an act of omission by an apathetic, indifferent professional who chooses not to act upon a situation. Inexperience is the lack of theoretical and practical medical knowledge.

It is difficult to characterize these modalities of culpability in a criminal responsibility process, especially inexperience in the case of a physician who can prove participation in specific courses and has a license to practice issued by the specialty society registered with the Regional Council of Medicine. However, in any of these modalities, if damage, a causal relationship and culpability are present, the anesthesiologist will be sanctioned accordingly.

A professional can commit a common crime, which can be perpetrated by any person, or a crime resultant from professional practice. The penal process is initiated by society and the state must penalize the physician who, voluntarily or not, engenders damage to others. Presumption of innocence must always guide penal responsibility inquiries.

Once adjudicated from the professional standpoint, an act may also qualify as involuntary manslaughter. Therefore, medical negligence can result not only in substantial restitutions but also in one to three years of confinement. If a physician has taken exceedingly reckless actions, he may even be prosecuted for homicide.

Intention refers not only to malice but also to accepting the risk of causing damage. Imprudence and negligence fall into the latter category, since they are so immeasurably severe that it would be unfair to allow them the reduced punishment that results from being categorized "unintentional". Confinement time for homicide varies from 6 to 20 years.

Lesser crimes with a maximal seclusion time of 2 years, except for homicide and serious bodily harm, only lead to confinement in case of recurrence. Some perpetrators may be punished with a fine and all of them are allowed a simplified process that may be resolved by an indenization agreement, by conditional suspension of the inquiry or by issuing an alternative punishment.

The anesthesiologist's activity

The nature of the obligation of the anesthesiologist depends on there being a contract between doctor and patient. In the case of private or health insurance services, there is a contractual aspect to this relationship. On the other hand, in the case of the public service, the doctor-patient relationship does not include that aspect.

Regarding ethics, the nature of the obligation of any physician to his patient is one of means (i.e. cannot promise results), whereas in law there are conflicting theories. With respect to anesthesiologists' activities and malpractice, there is a set of obligations that, if unobserved, may lead to liability.

In order to evaluate this responsibility, it is essential to categorize technically the obligations of the anesthesiologist. Classification of these activities may be divided in preanesthetic, anesthetic and postanesthetic.

Preanesthetic actions must be undertaken in order to gather information about the patient's condition and create a safer anesthetic plan, thereby decreasing the incidence of adverse effects. The anesthetic actions are the most crucial moments in an anesthesiologist's practice and also the moments in which most accidents occur. Care must be taken to verify correct application of drugs and techniques.

The responsibility of the anesthesiologist finishes in the postanesthetic period, after complete recovery of the patient's consciousness. Filling pre, trans and postanesthetic registries correctly and readably helps protect physicians against liability inquiries.

Informed Consent Forms

Offering patients a written informed consent form is a way of respecting self-determination, that is, the free will of individuals. It is essential for the physician to inform the pertinent details of the case to enable patients for autonomous and conscious decision-making.

Physicians, therefore, have a duty to inform the patient as broadly and clearly as possible of available options and details of his case. The written informed consent form must include a description of the proposed procedures, associated risks and

benefits, the possibility of requiring further information and it should also ascertain the patient's right to desist from the procedure at any time.

According to current regulations, it is not mandatory that the informed consent be written. However, documenting the patient's agreement is important for the anesthesiologist to defend himself in case of a future inquiry.

Conclusion

Medical studies and practice have suggested that anesthesiology entails substantial exposure to physical and psychic illness. Stress, anxiety and chemical dependence occur rather frequently.

Moreover, due to the nature of professional activity, anesthesiologists are susceptible to suicidal ideation, somatization of depressive states and burnout syndrome. These are complex issues, since they are related to the self-perception of performance and exert an impact on doctor-patient relationships and on the likelihood of medical malpractice claims.

Anesthesiologists have to answer for the consequences of their professional practice and also for facts that affect the rights of third parties. That means to say that they are liable to civil, criminal and ethical inquiries which may result in penalties for intentional or unintentional acts.

The Civil Code and the Consumer's Protection Code are beacons of the civil realm. The penal sphere is based on the Penal Code, whereas the ethical sphere is the competence of Medicine Councils based on the Medical Ethical Code.

In order to address this issue, studies have emphasized the need for practical measures. A better understanding of chemical dependence and education about it in medical schools can enhance early recognition. Stimulating spontaneous reach for treatment, opposing prejudice and educating physicians can help them refrain from self-medicating. Training medical teams to recognize, advise and confront addicted physicians, as well as creating specialized services for their treatment may help screen and detect cases, enhancing compliance to treatment and protecting physicians and patients alike.

The groundbreaking experience of CREMESP with precautionary suspensions of professional practice and the treatment of physicians with psychiatric illnesses suggests it is pertinent to expand this initiative to other states and create a national support system for physicians with chemical dependence.

Acknowledging the relevance of this issue, the Federal Council of Medicine (CFM), supported by the Brazilian Society of Anesthesiology (SBA), has created a specific committee for the creation of a national support system which will aid in the recovery and reentry of physicians into social, familial and professional life. This committee includes members of the Technical Committee of Anesthe-

siology and the Technical Committee of Psychiatry. It is a pilot project, initially focused on anesthesiologists, that shall be expanded in the future to assist all Brazilian physicians.

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