

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

4,800

Open access books available

122,000

International authors and editors

135M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.

For more information visit www.intechopen.com



Physician Burnout

*Bess Connors, Charlotte Horne, Valery Vilchez
and Sofya Asfaw*

Abstract

Burnout is pervasive among physicians and is rapidly becoming a pandemic in healthcare. It is characterized by increasing demands without adequate support and hallmarked by depersonalization, emotional exhaustion, and a reduced sense of personal accomplishment. It is essential to address burnout, as it can lead to decreased productivity, increased healthcare costs, medical errors, workforce attrition, depression, and even suicide. Many factors contribute to burnout, and it occurs at all stages of medicine: it can begin during medical school, intensify during the years of graduate medical education (GME) or residency training, and persist as residents become staff physicians. It affects both sexes, but may impact female physicians disproportionately. Impact can also vary among specialties. Recognizing the problem and intervening with unified physician and organization-directed solutions centered on well-being, efficient practice models, and goal prioritization may help to reduce the prevalence and effects of burnout.

Keywords: burnout, depersonalization, emotional exhaustion, suicidal ideation, attrition, patient safety, resilience, well-being

1. Introduction

Physician burnout is a quiet pandemic in health care. Its negative effects infiltrate the lives of those experiencing it and also negatively impact patient outcomes, increase medical errors, and decrease overall productivity. The number of physicians that experience burnout is staggering, with rates quoted from 50 to 67% [1, 2]. This is significantly higher than those seen in the general population, including occupations holding a professional degree [3]. Burnout is not only an issue of practicing physicians, but it is also common during graduate medical education and is becoming prevalent in medical students—even in their first year of study [4, 5]. An increasing amount of attention is being given to this issue due to the high prevalence in physicians in the USA and globally. Although rates of burnout differ between disciplines and gender [6, 7], it is pervasive in all types of medical specialties. Due to the prevalence of burnout in all stages of training, implementing programs focusing on awareness have become a focus in graduate medical education. Unfortunately, despite an increased awareness, burnout rates continue to rise [8]. Numerous factors have been associated with this including increased utilization of the electronic medical record, changes in physician payment structure, increasing workload despite resource deficits, increasing administrative burdens, and overall lack of autonomy.

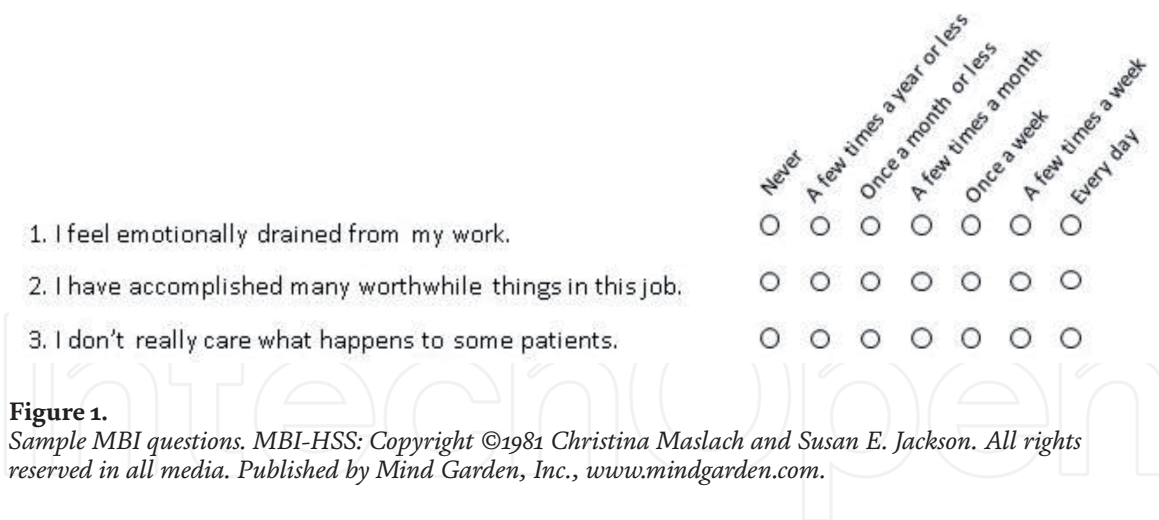


Figure 1. Sample MBI questions. MBI-HSS: Copyright ©1981 Christina Maslach and Susan E. Jackson. All rights reserved in all media. Published by Mind Garden, Inc., www.mindgarden.com.

Burnout was described by Freudenberg in 1974 as chronic stress due to intense work demands in the setting of inadequate resources [9]. It was further characterized by Maslach et al. based on three components: a state of depersonalization, emotional exhaustion, and reduced personal accomplishment [10]. When emotional exhaustion contributes to burnout in providers, they feel as though they no longer have the emotional capability to care for patients. Depersonalization results in cynical feelings toward patients, colleagues, or both. Personal accomplishment is decreased when physicians experience less satisfaction from or perceive less value in completed tasks. High levels of emotional exhaustion and depersonalization combined with low levels of personal accomplishment result in burnout. More recently, DeCaporale et al. described it as “an emotional manifestation of a profound mismatch between high expectations for one’s future and the reality of daily life” [11].

Not only does burnout negatively affect overall work productivity and patient care, but burnout has been closely associated with depression [12] and other mental health issues. The rate of suicide and suicidal ideation is higher among physicians than in the general population [13], and physicians are more likely to commit suicide than non-physicians [14]. Addressing burnout is essential, as 400 physician lives are lost to suicide each year in the USA alone [14]. It is important to understand the factors that lead to burnout in students, GME trainees, and staff physicians and to implement strategies to address them.

1.1 Measuring burnout

The most common method of assessing burnout is based on the Maslach Burnout Inventory (MBI) (**Figure 1**). First introduced in 1981, the MBI is an externally validated survey that measures dimensions of burnout including emotional exhaustion and depersonalization. Using language that elicits personal attitudes, respondents evaluate statements indicating how frequently they relate to the statement using a 7-point scale. Higher-scored responses in the emotional exhaustion and depersonalization sections correspond to a higher likelihood of burnout, while lower scores in the personal accomplishment subscale indicate increased risk of burnout.

2. Factors contributing to physician burnout

Work in the medical field provides unique challenges. From early in GME training and even medical school, student doctors are exposed to death and human suffering on a daily basis. Ethical conflicts also present themselves—some with no

satisfactory solution. The work has long hours, and there are ever-increasing clerical requirements. As such, factors thought to contribute to physician burnout are numerous: some include work-related factors at the individual and organizational levels, as well as more personal factors which may leave some physicians predisposed to burnout.

The era of the electronic health record (EHR) has arrived, and along with the myriad benefits, physicians are feeling the negative effects. Many physicians now spend a greater proportion of their time documenting care than providing it face-to-face with patients [15]. In the USA, documentation has become onerous due to requirements of legal compliance and billing. In the development of the EHR, financial and compliance features came first and often at the cost of usability. The division of physician time and attention between patients and the EHR has led to less fulfilling relationships with patients and a growing concern that the EHR may drive dissatisfaction and burnout. Electronic order entry alone was associated with a 29% increase in physician burnout [16]. The EHR is not the only example of workplace inefficiencies adding to burnout. Inefficient processes and clerical work not contributing to meaning in a physician's work likely contribute to burnout as well.

This loss of "meaning in work" is difficult to define yet is a strong contributor to dissatisfaction. Physicians who spend less than 20% of their work effort on the activity they find most personally meaningful are nearly three times more likely to be burned out than those who spend at least 20% of their work effort on such an activity [17]. It is possible that the shift in physician employment structures from private practice to employed providers has contributed to a loss of autonomy and diminished ability to choose one's work activities. This may contribute to the reported loss of meaning in work. When leadership makes a greater effort to seek input from physicians, recognize their individual contributions, and grant them greater control in workplace matters, physicians show greater levels of satisfaction and lower levels of stress [18]. The protective effect suggests that loss of autonomy is associated with increased rates of burnout.

The more a physician works, the more likely she will suffer from burnout. Multivariable analyses of data from cross-sectional studies of physicians have reported independent relationships between burnout and work hours, call shifts, time spent on work from home, and the presence of work-home conflicts. As an example, the presence of work-home conflicts more than doubles the incidence of burnout [2]. Unfortunately, many hospital systems are responding to small financial margins and patient access issues by demanding that physicians see and care for ever-increasing numbers of patients, necessitating longer work hours. The cycle will not be sustainable as burnout will lead more physicians to leave the workforce or reduce hours—seeing fewer patients.

Finally, it seems as though nearly any demographic collected has led to observed differences in rates of burnout. Independent relationships between burnout and physician sex, age, educational debt, relationship status, age of children, and spousal/partner occupation have all been reported [2]. Special attention has been paid to burnout during the different stages of physician training, where it is seen in both undergraduate and graduate medical education. Individual personality, personal experiences, and interpersonal skills may impact coping mechanisms and resilience among physicians; however, it does not appear that those entering the medical field are more predisposed or vulnerable to stress and burnout than the general population [19]. It is something about the work, and not the worker, that is defective. Some special cases including burnout across genders, stages of training, and in the surgical specialties will be discussed further.

3. Special cases

3.1 Gender differences in burnout

Female physicians have been shown to experience burnout at a higher rate than males [7]. As females currently make up close to 50% of medical graduates, compared to just 8% in 1965 [20], gender disparity in burnout is likely to have an increasing effect as more women enter training and become practicing physicians. Some of the proposed factors influencing higher burnout rates are differences in work-life balance and gender roles women are expected to fulfill both in and out of the hospital.

A study comparing female to male surgeons by Dyrbye et al. explored certain demographic and social factors in an effort to explain why female doctors were more likely to become burned out. Factors that were likely to affect work-life balance including age, number of children, marital status, and other partner characteristics were compared between male and female surgeons. The study found that female physicians were more likely to be married to a spouse that also worked outside home compared to the male colleagues [7]. The spouses of these women were not only more likely to be doctors but also more likely to be surgeons when compared to their male colleagues. Despite more commonly being involved in situations where both partners were working, often in equally demanding careers, women played a more significant role in child rearing than their male colleagues.

Dyrbye went on to further evaluate how personal achievement may be different between genders. They demonstrated that compared to male surgeons, female surgeons felt that child rearing slowed their career advancement. In partnerships where both individuals were employed and especially in the case where both were employed as physicians, conflicts arose between the careers of the two individuals. These career conflicts were more common for women and less likely to resolve in their favor. Career conflicts were more likely to resolve in favor of the surgeon when the surgeon was male compared to when the surgeon in the partnership was female [7].

Female physicians' roles in their home life differ significantly from those of their male colleagues, but their roles in the hospital also differ. Female physicians have been found to treat a distinct patient population, and the expectations women face from those patients is also somewhat different from those faced by their male colleagues. This may begin to explain the higher incidence of burnout in women. Female physicians see a higher number of patients with more complex psychosocial issues, and patients often expect female physicians to be more empathetic [21, 22]. This combination of more complex issues arising and increased expectations of empathy from female providers leads to longer office visits [23]. Female physicians' appointment duration has been shown to be 10% longer than that of their male colleagues despite being assigned equal clinic time slots [24]. Female physicians face difficult time constraints: as appointments risk running over, these women find they are also more likely than their male counterparts to be evaluated negatively in the event that they end the encounter sooner than the patient would like. The increasing pressure to remain empathetic, address all patient concerns, conduct clinic efficiently, provide appropriate patient care, support a significant other, and play a major role in child rearing, all while attempting to advance her career likely causes a significant amount of emotional exhaustion which may lead to higher rates of burnout for female physicians.

3.2 Burnout in training

3.2.1 Burnout in medical school

Burnout is not limited to those that have been in practice for numerous years. Even medical students in their first year of training report experiencing burnout.

Santen et al. showed that as many as one third of medical students displayed a moderate to high degree of burnout, with rates of burnout as high as 41 and 43% in the second and third years of medical school, respectively [25]. There are numerous transitions that medical students experience throughout their education which may result in burnout. In the first 2 years of school, significant classroom responsibilities and pressure to perform well on tests as well as to retain pertinent information can be overwhelming. As the student transitions to their clinical years, feelings of decreased personal accomplishment; the transition to a clinically based education; rotation interactions with various physicians, residents, and patients; as well as the residency application process may increase emotional exhaustion and depersonalization.

In the first 2 years of medical school, burnout is strongly associated with the amount of support perceived by the student from their faculty [26]. As students transition to clinical practice and prepare residency applications in their third year of training, emotional exhaustion and depersonalization peak. It is this year that students report the highest degree of burnout [25, 26]. Reasons for this include exposure to cynical residents, the organization of clerkship rotations, and increased hours spent in the hospital due to the requirement to take overnight call [27].

Life events experienced during medical school may also contribute to the presence or absence of burnout in students. Using survey data from medical students within Minnesota, Dyrbye et al. evaluated how either positive or negative life events affected overall rates of burnout in medical students. Like their peers, students in medical school have to deal with personal or family illness or death as well as marriage or the birth of a child. However, unlike their peers, these must be handled when schedules are less than flexible. Often, medical students are required to relocate away from their families to pursue their education, which can make coping with personal or family illness exceedingly difficult. Mental health has been shown to deteriorate during medical school. Burnout in medical students is extremely worrying due to the high association between burnout and suicidal ideation. Approximately 11% of medical students report suicidal ideation [27]. Students that reported feeling burnout were up to three times more likely to consider suicide. Students with high rates of depersonalization were especially at risk for suicidal ideation.

3.2.2 Burnout in graduate medical education

Residency is a challenging time regardless of which specialty a resident chooses. During this time, residents must obtain a significant amount of clinical knowledge, balance daily patient care activities, and deal with difficult complications, all with little control over their schedules. As many as 69% of surgical residents meet the criteria for burnout and 50% of surgical residents report high emotional exhaustion [28]. Medicine residents were similarly affected with as many as 76% of residents feeling burned out [29].

Long work hours, multiple call shifts, and lack of sleep are key features of residency that have been evaluated as potential causes of burnout. Other possible factors that may result in high degrees of burnout in residency are low sense of personal accomplishment due to feelings of decreased self-efficacy and competency. Purdy et al. surveyed family medicine residents to catalog perceived causes for burnout in residency. The residents in this survey reported significant time constraints as the major factor leading to burnout [30]. These findings were confirmed in a study involving anesthesia residents that cited lack of time but additionally noted lack of control over time management, inherently difficult job situations, and interpersonal conflicts as contributing causes to burnout [31]. Although residents reported that feeling overwhelmed was likely to increase the risk of burnout, it did

not correlate with total hours at work but rather with the number of emergency admissions and patient deaths [32].

Self-efficacy may also play a significant role in the overall resident well-being. Achieving self-efficacy often correlates to the confidence that one has mastered a certain skill, and this appears especially true in specialties that require a significant amount of technical instruction [33]. As adjustments to duty hour restrictions have decreased total hours residents spend in the hospital, residents' perception of their self-efficacy and overall well-being may also decrease. Milam et al. evaluated the relationship between self-efficacy and well-being in a cohort of surgical residents. They found that residents that had high levels of self-efficacy reported less emotional exhaustion as well as higher levels of personal accomplishment, which in turn decreased burnout [34].

3.3 Burnout in surgery

Surgeons not only have a technically demanding career, but changes in delivery of medicine have transitioned to a larger amount of administrative work. Rates of burnout in surgeons are rising, and greater than 50% of surgeons report feeling burned out in some surgical subspecialties [8]. Factors specific to the practice of culture of surgery may put surgeons at risk for burnout.

Complications are common in surgery. Bosk stated that “the specific nature of surgical treatment links the action of the physician and the response of the patient more intimately than in other areas of medicine” [35]. Despite complications being a reality of the practice of surgery, often the emotional aspects of dealing with difficult complications are not routinely addressed. Luu et al. contend that there is a significant impact on the healthcare provider after an adverse event. Adverse events can lead to burnout and depression [36]. Often the necessary steps are not taken to reconcile with the complication. Increasing time constraints due to clinical demand do not allow the time to resolve these emotional disturbances after a complication, and surgeons may feel they need to “get back on the horse” as quickly as possible [36].

The culture of surgery also reinforces that significant emotional events should be handled privately. A study conducted by Lemaire and Wallace reported that the three most common coping mechanisms employed by surgeons include keeping stress to oneself, concentrating on what to do next, and going on as if nothing happened [37]. Having to silently confront significant complications on top of a demanding clinical schedule and incentive-based pay structures may contribute to the high degree of burnout seen in the surgical community.

4. Impact of physician burnout

Burnout has numerous effects on those who suffer from it. Outside the workplace, providers with burnout may suffer from marital problems, depression, substance abuse, and even suicide [11]. Burnout is also associated with negative health implications including sleep disturbances, hypertension, anxiety, and myocardial infarction [38]. Burnout not only affects the personal lives of those who suffer from it, but it also results in increased callousness and lack of empathy toward patients and can result in less attentiveness to patient care. This can lead to increased adverse events and errors [39–41]. The result is decreased patient satisfaction scores, increased medical error, increased short-term and long-term disabilities of those suffering from burnout, and an increase in physician turnover as providers leave patient care positions in efforts to mediate symptoms of burnout.

4.1 Consequences to physician health

When examining the effects of burnout on physician health, it can be difficult to tease apart cause from correlation. The very question of whether burnout is a unique entity, or rather a form of depression, is debated. In a study that directly compared depressive symptoms in burned out workers and clinically depressed outpatients using a DSM-based approach, no diagnostically significant difference was observed between the two groups [42]. The team concluded that no burned out participant appeared to be free of depressive symptoms. At a symptom level, it has been difficult to isolate substantial differences between depression and burnout [12]. What probably matters more than the exact distinction between the two entities is their shocking prevalence and strong correlation that has been shown in numerous studies [43, 44].

Among the three most studied components of burnout, emotional exhaustion shows the strongest link to depression with moderate to high correlations. The link of depression with depersonalization and reduced personal accomplishment tends to be weaker [42].

Burnout is also strongly correlated with substance abuse in physicians [45]. In a study which surveyed surgical fellows only, alcohol abuse was found at a rate of 13.9% for male surgeons and 25.6% for female surgeons. Since women in the general population typically see reported rates of alcohol abuse half those of their male counterparts, these numbers are particularly concerning for the female surgeon group.

Physicians are also at high risk for suicidal ideation and death by suicide beginning as early as medical school [4]. The suicide rate among male physicians is more than 40% higher than that found among men in the general population, and the suicide rate for female physicians has been predicted as much as 130% higher than that of the general female population [46]. While the male suicide rate is four times the female rate in the general population, in the physician group, men and women have equivalent rates of suicide. The association between elevated suicide risk in physicians and prevalence of burnout has been investigated, with the presence of burnout appearing to double the risk of suicidal ideation [47].

4.2 Consequences to patient safety

After the 1999 Institute of Medicine report suggested that medical errors were a leading cause of preventable death in the USA, patient safety came to the forefront of healthcare policy [48]. Despite hard work in this area, medical errors by physicians remain a common cause of morbidity and mortality. Burnout has been linked with medical errors, and its presence doubles reported rates of medical errors [39]. Associations between burnout and medical errors do not prove causality, but medical errors are definitely a source of distress for physicians [49]. This is the basis for the “second victim” theory—providers who feel personally responsible for poor patient outcomes can become traumatized by these events. There is, however, increasing evidence that there is a bidirectional relationship between medical errors and physician distress. The longitudinal Internal Medicine Resident Well-Being (IMWELL) study found not only that self-perceived major medical errors were associated with worsening burnout, depressive symptoms, and decrease in quality of life but also that higher levels of burnout were associated with increased odds of reporting a major medical error in the subsequent 3 months [50].

The reported impact of medical errors and suboptimal care on patient morbidity and mortality is disturbingly high. In a review of 111 deaths at seven Veterans Affairs medical centers, 22.7% of active-care patient deaths were rated as at least

“possibly preventable by optimal care,” with 6.0% rated as “probably or definitely preventable” [51]. This is similar to previously reported rates [52, 53]. If, as stated above, burnout doubles the risk of medical errors, and medical errors have a high impact on patient mortality, then burnout should be considered a major issue for public health. In the Minimizing Error, Maximizing Outcome (MEMO) study, a conceptual model was used to examine whether stressed, dissatisfied, and burned out physicians deliver poorer quality care. In a self-report, these physicians do demonstrate a greater likelihood of making errors and more frequent instances of suboptimal patient care [54]. This aligns with earlier studies, one of which found 75% of the resident population examined met criteria for burnout and that these burned out residents were two to three times more likely to report suboptimal patient care practices [55]. Beyond increased hospital morbidity and mortality, this suboptimal care in the hospital setting may have other long-term effects. Patients who are cared for by burned out physicians experience longer recovery times post-discharge. This effect was tied in particular to depersonalization, a hallmark of burnout [56]. There is also an increased likelihood that burned out surgeons will be named in a malpractice suit (17% increase) [2]. One might imagine this could be due to the combination of increased medical errors and depersonalization leading to unsatisfactory communication and, thus, poorer relationships with patients. Patients do report lower satisfaction with their medical care and show poorer adherence to the doctor’s recommendations when their physician is suffering from burnout [57]. Compromised physicians lack the capacity to build the personal trust and rapport in relationships with their patients that leads to improved compliance and patient satisfaction with their care.

4.3 Consequences to the healthcare system

Cross-sectional studies have associated physician burnout with decreased productivity, job dissatisfaction, and a more than doubled self-reported intent to leave one’s current practice for reasons other than retirement [58]. Some physicians do leave the work force, and the cost of replacing them, from recruitment to lost productivity while the position is vacant, can total well over 1 million dollars in some markets. For those physicians that push through burnout, many will reduce work hours and workload. In a study published in 2016, a one point increase in emotional exhaustion or decrease in work satisfaction on a 7-point scale was associated with greater likelihood of reducing work hours (measured by administrative FTE data) [40]. Even those who do not officially leave the workforce or decrease hours demonstrate greater absenteeism and lower productivity [41]. At a time when physician shortages loom, decreased productivity in the physician workforce represents a serious threat to our ability to provide care to patients in need. Aside from the cost incurred through attrition and lost productivity, there are other ways in which burnout may impact the ballooning cost of medical care in the USA—medical errors and malpractice claims, both discussed above, are very costly. There is some evidence that physicians experiencing burnout or high workloads also have higher rates of referral to specialists and the use of diagnostic tests which may translate into additional costs for patients and insurers [59].

5. Recognizing the problem

Clinician well-being is crucial for safe, high-quality patient care. As we have described previously, burnout is associated with serious risks to both physicians and patient care; thus, it is imperative that healthcare providers have access to

evidence-based interventions that reduce the risk for burnout. It is essential to understand that when physicians are burned out, healthcare system performance is suboptimal. Awareness of this problem in the healthcare community is essential. The difficulty with this subject is recognizing the drivers and applying timely interventions.

Interventions for burnout have been classified into two main categories: physician-directed and organization-directed, with the latter often targeting the working environment. Physician-directed interventions typically involve mindfulness or cognitive behavioral techniques to identify burnout symptoms early, improve communication skills, and augment personal coping strategies. Organization-directed interventions can involve simple changes in schedule or workload or more ambitious changes in operation of practices within the institution. These usually involve improved teamwork, supervision to reduce job demand, enhanced job control, adjusted work-life balance, and increasing the level of participation in decision-making or leadership among the healthcare providers [60, 61].

Despite some limitations (including focus on single interventions rather than combined approaches, limited application of randomized and controlled designs, difficulties in generalization of results across specialties), intervention studies have demonstrated reductions in the proportion of physicians with burnout symptoms.

A meta-analysis by West et al. evaluated outcomes of potential intervention for burnout. Individual burnout domain scores were scaled to the relevant full Maslach Burnout Inventory range [60]. The authors report an overall burnout decrease of 10% (from 54 to 44%), emotional exhaustion score decrease of 2.65 points in 36 studies, and depersonalization score decrease of 0.64 points in 36 studies.

Panagioti et al. performed a meta-analysis to evaluate the effectiveness of interventions to reduce physician burnout and examine whether different types of interventions, physician characteristics, or healthcare settings were associated with decreased burnout symptoms. Three prespecified subgroup analyses were carried out: (1) physician-directed vs. organization-directed interventions, (2) physician working experience of greater than or less than 5 years, and (3) primary care vs. secondary care settings. The authors found that interventions were associated with small but significant reductions in burnout. Of note, the effects of organization-directed interventions were significantly larger than the effects of physician-directed interventions [62]. The results also suggested that interventions targeting experienced physicians and delivered in primary care setting showed greater effectiveness when compared with interventions targeting less experienced physicians and delivered in secondary care settings.

5.1 Resident wellness in graduate medical education (GME)

Burnout, depression, and suicidality among residents of all specialties have become a critical focus for the medical education community, especially among learners in GME. In 2017, the Accreditation Council for Graduate Medical Education (ACGME) updated the Common Program Requirements to focus more on resident well-being. These changes establish a mandate to educate residents and faculty members in the identification of burnout, depression, and substance abuse and to implement programs that encourage optimal resident and faculty well-being. Some of the programs established by the ACGME include (1) Clinical Learning Environment Review CLER Program which provides sponsoring institutions with periodic feedback from site visits addressing duty hours, fatigue management and mitigation, as well as well-being, (2) back to bedside initiatives to empower residents to develop projects that address burnout by fostering meaning in their learning environments, and (3) Action Collaborative on Clinician Well-Being

and Resilience in conjunction with the American Association of Medical Colleges (AAMC) and the National Academy of Medicine (NAM).

5.2 Trial interventions and effects

Evidence has linked 1-point changes in burnout scores with meaningful differences in self-perceived major medical errors, reductions in work hours, and suicidal ideation. These concerns have prompted calls for increased attention to physician well-being, including efforts targeting burnout [60, 61].

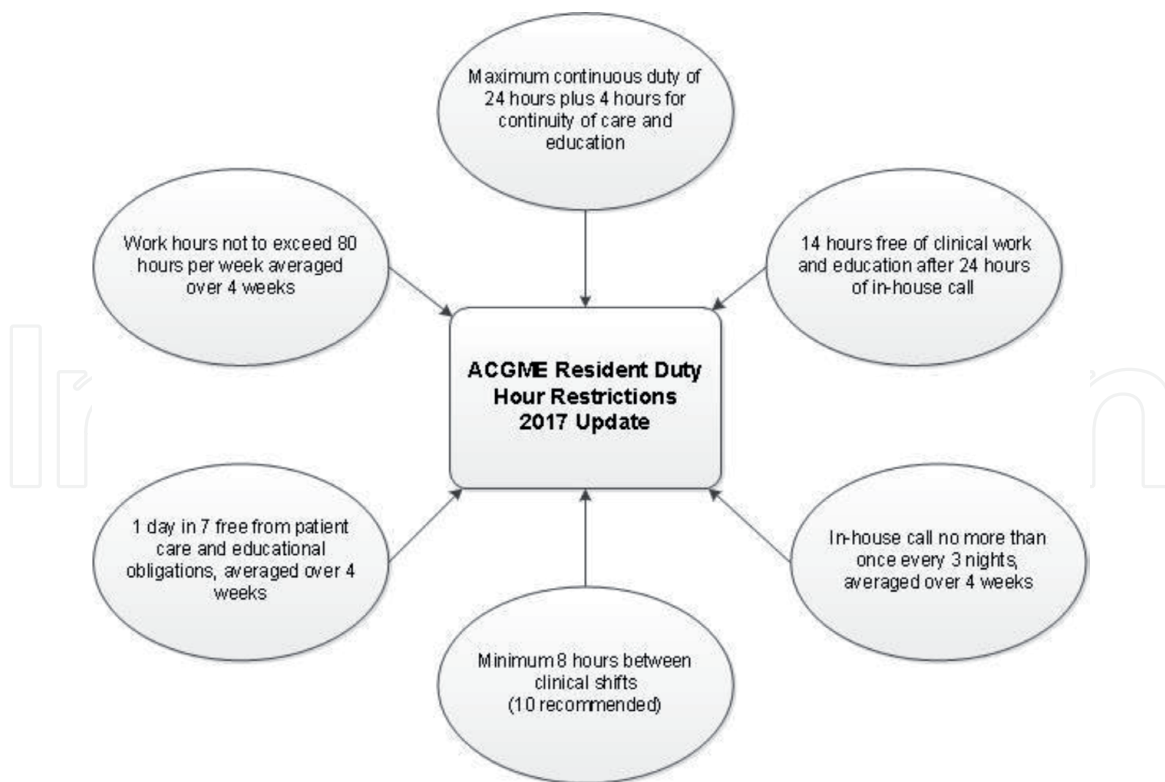
Effective physician-directed strategies include mindfulness-based approaches, stress management training, small group curricula, belonging intervention, and Balint intervention. Balint intervention, a method which came to prominence in the 1950s in England, allows groups of practitioners to focus on the emotional content of doctor-patient relationships through case presentation followed by general discussion with emphasis placed on emotional reaction. Effective organizational approaches include duty hour regulations, shortened attending rotation length, and locally developed modifications to clinical work processes (**Table 1**).

Medical training, particularly residency, poses many challenges that may lead to burnout. The ACGME implemented mandated nationwide restrictions on resident work hours as of July 1, 2003. The new requirements include an 80-hour weekly limit, averaged over 4 weeks, at least 8 hours of rest between duty periods, a

Driver	Organization-level solutions	Individual-level solutions
Excessive workload	<ul style="list-style-type: none"> Duty hour limits Appropriate distribution of job roles and time needed for each role 	<ul style="list-style-type: none"> Part-time status Informed practice choices
Work inefficiency	<ul style="list-style-type: none"> Optimized EMS Appropriate interpretation of regulatory requirements 	<ul style="list-style-type: none"> Skill training sessions Delegate work appropriately
Lack of work-home integration	<ul style="list-style-type: none"> Respect for home responsibilities in setting office and meeting schedules All required work tasks should be able to be completed within expected work hours Support flexible work schedules 	<ul style="list-style-type: none"> Attention to self-care
Loss of autonomy Loss of meaning from life	<ul style="list-style-type: none"> Physician leadership and shared decision-making 	<ul style="list-style-type: none"> Stress management and resiliency training Positive coping strategies Mindfulness
Loss of meaning from work	<ul style="list-style-type: none"> Promote shared core values promote physician communities Protect physician time with patients Professional development opportunities support marginalized groups Leadership training Awareness around physician burnout 	<ul style="list-style-type: none"> Self-awareness of most fulfilling work roles Mindfulness Promote sharing work experiences Belonging/Balint

Adapted from: West et al. [2].

Table 1.
Drivers and selected solutions for physician burnout.

**Figure 2.**

ACGME clinical work hour common program requirements.

24-hour limit to continuous duty, 1 day in 7 free from patient care, and in-house call no more than once every 3 nights averaged over 4 weeks (see **Figure 2**).

Studying the impact of the 80-hour resident workweek on surgical residents and attending surgeons implemented by the ACGME in a single institution, Hutter et al. reported that surgical residents had decreased burnout scores, with significantly less emotional exhaustion (Maslach Burnout Inventory (MBI): 29.1 “high” vs. 23.1 “medium,” $p < 0.02$). Residents seem to have better quality of life both in and out of the hospital: they reported getting more sleep, lighter workload, and increased motivation to work (Herzberg Motivation Dimensions). However, for attending surgeons, MBI scores on personal accomplishment, emotional exhaustion, and depersonalization resulted in the “medium” range for every category at both time points, showing no significant change after duty hour restrictions [63].

Salles et al. [64] studied the effect of the belonging intervention on surgical resident attrition. The authors included participants from seven surgical specialties who were randomized into either belonging treatment or control condition. Junior residents read anecdotes from senior residents describing the challenges the seniors had faced early in residency (treatment condition) or describing challenging ethical dilemmas they had encountered (control condition). Juniors were then asked about their attitudes and beliefs as a proxy for future intent to leave residency. The authors reported that residents who felt a stronger sense of belonging were more likely to think they would complete residency. After the intervention, residents in the treatment condition had significantly lower rates of burnout than those in the control condition.

Formal implementation of a program to improve resident well-being has been proven to positively impact residents’ perceived stress, emotional exhaustion, emotional intelligence, life satisfaction, and their perception of the residency program [65]. A group from the University of Arizona created a program designed to improve surgical resident well-being named Energy, Leadership, Well-Being and Resiliency Program. Forty-nine general surgery residents participated in the program. They were assessed at baseline and 1 year after implementation using

the Energy Leadership index, which measures emotional intelligence, MBI score, Perceived Stress Scale, the Beck Depression Inventory, and the annual required ACGME resident survey. The authors reported that 1 year after implementation, resident scores on the Energy Leadership Index improved, residents' perceived stress decreased from baseline, and scores on the emotional exhaustion scale of the MBI decreased. Resident-reported satisfaction increased in many areas over the 1 year interval: satisfaction with leadership skills, work relationships, communication skills, productivity, time management, and work-life balance.

5.3 Listen-Act-Develop model: the Mayo Clinic experience

The Listen-Act-Develop model is a physician engagement model that has been established by the Mayo Clinic and is practiced as a core value. This model is based on organization-sponsored practice improvement initiatives created, developed, and implemented by staff members [66, 67].

The four steps in the process are: (1) Listen: to actively seek specific burnout drivers and create a mitigation plan focused on the driver of greatest concern; (2) Act: to identify physician leaders and work with them to create solutions, facilitate implementation, monitor outcomes, and finally communicate results of the initiative to all staff members; (3) Develop: to support physician leadership development with mentoring, assessment, assignments, and goal planning; and (4) Repeat: to revisit findings from focus groups to identify the next round of initiatives to decrease specific burnout drivers

Since 2013, the institution's board of governors has sponsored an in-depth burnout engagement initiative with physicians from seven high-opportunity clinical departments. Initially, a team of two physicians and one administrator met with the division or department chair to obtain his or her opinions regarding local challenges and issues. They then conducted multiple focus groups with the members of the division or department and summarized the areas of greatest concern for the division or department chair. The institutional drivers of burnout identified through this process were communicated to the appropriate management groups and addressed by means of a department-organization partnership. A Burnout Mitigation Process Playbook was developed out of this process which has been used to facilitate the burnout mitigation process [68]. Follow-up surveys of physicians in these seven divisions and departments showed a median burnout reduction of 11 percentage points. After administration of the 2013 all-staff survey, work units were identified on the basis of lower scores for engagement and overall satisfaction (<75% on overall satisfaction and <78% on engagement). Fifty percent of the targeted units experienced an increase in satisfaction, engagement, or both of these after actions were implemented [66].

5.4 A unified approach

In 2017, the NAM in conjunction with GME and AAMC introduced the Action Collaborative on Clinician Well-Being and Resilience, a network of more than 60 organizations committed to battle clinician burnout. There are three main goals of this action collaborative: (1) identify and actively seek signs of clinician anxiety, depression, stress, and suicide, (2) improve understanding of challenges to clinician well-being, and (3) advance multidisciplinary solutions to improve patient care by caring for the caregiver. Five working groups will meet over the course of 4 years to identify evidence-based strategies to improve clinician well-being at both the individual and systems levels. Activities of these groups include a series of NAM perspective discussion papers and a model that reflects the most important domains

affecting clinician well-being [69]. This is an example of the unified approach necessary to address the problem of physician burnout.

5.5 Moving forward

Burnout is prevalent among physicians. Meaningful progress requires combined efforts by national organizations and individual physicians, as each is responsible for factors that contribute to the problem and must own their part of the solution.

Many knowledge gaps still remain in the understanding of physician burnout. It is necessary to continue following the outcomes of interventions aimed at mitigation and prevention of burnout that have been published in the literature. The effect of physician-oriented and organizational interventions in combination has also not been studied.

Organizational efforts that target burnout are an essential step to enhance physician engagement and improve teamwork. Regulations related to documentation, adequate and meaningful use of EHRs, and workflow should be implemented. Insurance companies' requirements that physicians perform and document unnecessary elements that do not improve medical care should be eliminated. The National Institutes of Health should allocate funds to support research on clinician well-being and its impact on the care delivery system as well as strategies looking into improvement of work-life balance. Organizational policies that require physician maintenance of their certification must be accompanied by appropriate allocation of protected time for physicians to complete these tasks.

Healthcare institutions should recognize the potential effect of physician well-being on the quality of their performance. Well-being should be assessed as an institutional performance metric alongside measures such as cost, patient volume and patient satisfaction. This could help to allocate resources to work units in greatest need. Practice models proven to increase productivity and efficiency should be identified, adapted to fit the organization, adopted, and spread.

Physicians should also do their part. Regular self-evaluation should be considered a standard of optimal professionalism. Adequate sleep, family time, exercise, and attention to personal medical needs should be considered a minimal standard

Level	Proposed solutions
Organizational effort	<ul style="list-style-type: none"> • Allocation of funding/support for research on physician well-being • Optimize use of EHR • Establish boundaries with insurance companies regarding required documentation to minimize physician workload. Appropriate interpretation of regulatory requirements • The use of institutional metrics like cost, patient volumes, and patient satisfaction to assess well-being • Allocation of resources to work units in greatest need • Leadership training
Individual effort	<ul style="list-style-type: none"> • Enhance self-awareness. Regular self-evaluation should be priority of the core component of professionalism • Ensure adequate sleep, exercise, and/or family time • Prioritize goals • Optimization of daily schedules; limit obligations to those required

Table 2.
Proposed solutions for physician burnout.

for self-care. Building community at work and connections with colleagues has also been shown to reduce burnout and should be pursued [70].

Lastly, individual physicians should prioritize life goals. These goals should be realistic. Daily schedules should be optimized, limiting obligations and including protected time dedicated to self-care. The best way to do this is by learning effective and professional strategies to say “no.” Individuals must continually evaluate their current condition, compare it with the ideal situation, and make the specific changes needed to approach the ideal state. When the status quo diverges from the ideal, change must be sought (Table 2).

6. Conclusion

Burnout, characterized by depersonalization, emotional exhaustion, and reduced personal accomplishment, has become a pandemic in healthcare. It has been associated with higher rates of depression among physicians, and its negative effect on overall work productivity and patient care is well established. Multiple factors contribute to physician burnout including work-related factors (work hours, call shifts, time spent on work from home, and the presence of work-home conflicts) as well as personal factors (sex, age, educational debt, relationship status, and presence of children). Higher rates of burnout have been reported among female physicians, and burnout is reported in both sexes as early as the first years of medical school. Burnout is also prevalent in both undergraduate and graduate medical education, and programs to mitigate burnout in these settings have been proposed. The consequences of physician burnout range from personal effects, such as increased rates of depression, substance abuse, sleep disturbances, and even suicides, to patient safety concerns, such as increased occurrence of medical errors, suboptimal patient care, and increased litigation. Physician-directed interventions, such as mindfulness and cognitive behavioral techniques, target identification of burnout symptoms and development of personal coping strategies. Organization-directed interventions that involve workload changes, operation practices within the institution, increased level of leadership, and participation in decision-making among healthcare providers have also been proven to reduce the rates of burnout. Institutional efforts like the Energy Leadership Well-Being and Resiliency Program from University of Arizona and the Listen-Act-Develop Model from Mayo Clinic and national strategies such as the Action Collaborative on Clinician Well-Being and Resilience network from the National Academy of Medicine have been launched to identify burnout drivers and symptoms and encourage timely adoption of changes to battle these drivers and achieve optimal patient care. Awareness of this problem among individual physicians and the healthcare community is imperative. Recognizing the drivers and personal triggers of burnout and applying timely interventions are the keys to mitigating this harmful syndrome.

Conflict of interest

The authors have no conflicts of interest to disclose.

IntechOpen

IntechOpen

Author details

Bess Connors[†], Charlotte Horne[†], Valery Vilchez[†] and Sofya Asfaw^{*}

Department of General Surgery, Cleveland Clinic Foundation, Cleveland, OH, USA

*Address all correspondence to: sofya.asfaw@gmail.com

[†]These authors share equal contributions to this work.

IntechOpen

© 2019 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] Rotenstein LS, Torre M, Ramos MA, et al. Prevalence of burnout among physicians: A systematic review. *Journal of the American Medical Association*. 2018;**320**(11):1131-1150
- [2] West CP, Dyrbye LN, Shanafelt TD. Physician Burnout: Contributors, consequences and solutions. *Journal of Internal Medicine*. 2018;**283**(6):516-529
- [3] Shanafelt TD, Boone S, Tan L, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. *Archives of Internal Medicine*. 2012;**172**(18):1377-1385
- [4] Dyrbye L, Thomas MR, Massie FS, et al. Burnout and suicidal ideation among US medical students. *Annals of Internal Medicine*. 2008;**149**(5):334-341
- [5] Thomas NK. Resident burnout. *Journal of the American Medical Association*. 2004;**292**(23):2880-2889
- [6] Balch CM, Shanafelt TD, Sloan JA, et al. Distress and career satisfaction among 14 surgical specialties, comparing academic and private settings. *Annals of Surgery*. 2011;**254**(4):558-568
- [7] Dyrbye LN, Shanafelt TD, Balch CM, et al. Relationship between work-home conflicts and burnout among American surgeons: A comparison by sex. *Archives of Surgery*. 2011;**146**(2):211-217
- [8] Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. *Mayo Clinic Proceedings*. 2015;**90**(12):1600-1613
- [9] Freudemberger HJ. Staff burnout. *Journal of Social Issues*. 1974;**30**:159-165
- [10] Maslach C, Jackson SE, Leiter MP. *Maslach Burnout Inventory Manual*. 3rd ed. Palo Alto, CA: Consulting Psychologist Press; 1996
- [11] DeCaporale-Ryan L, Sakran JV, Grant SB, et al. The undiagnosed pandemic: Burnout and depression within the surgical community. *Current Problems in Surgery*. 2017;**54**(9):453-502
- [12] Bianchi R, Schonfeld IS, Laurent E. Burnout-depression overlap: A review. *Clinical Psychology Review*. 2015;**36**:28-41
- [13] Schernhammer ES, Colditz GA. Suicide rates among physicians: A quantitative and gender assessment (meta-analysis). *The American Journal of Psychiatry*. 2004;**161**(12):2295-2302
- [14] Andrew LB. Physician Suicide: Overview, Depression in Physicians, Problems With Treating Physician Depression. [online] *Emedicine.medscape.com*. 2016 Available at: <https://emedicine.medscape.com/article/806779-overview> [Accessed 4 Mar. 2019]
- [15] Downing NL, Bates DW, Longhurst CA. Physician burnout in the electronic health record era: Are we ignoring the real cause? *Annals of Internal Medicine*. 2018;**169**(1):50-51
- [16] Shanafelt TD, Dyrbye LN, Sinsky C, et al. Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. *Mayo Clinic Proceedings*. 2016;**91**:836-848
- [17] Shanafelt TD, West CP, Sloan JA, Novotny PJ, Poland GA, Menaker R, et al. Career fit and burnout among academic faculty. *Archives of Internal Medicine*. 2009;**169**(10):990-995
- [18] Linn LS, Brook RH, Clark VA, Davies AR, Fink A, Koscoff J. Physician

and patient satisfaction as factors related to the organization of internal medicine group practices. *Medical Care*. 1985;**23**(10):1171-1178

[19] Tyssen R, Vaglum P, Grønvold NT, Ekeberg Ø. Factors in medical school that predict postgraduate mental health problems in need of treatment. A nationwide and longitudinal study. *Medical Education*. 2001;**35**(2):110-120

[20] Association of American Medical Colleges. FACTS: Total graduates by U.S. medical school and sex, 2002-2010. 2012. Available from: https://www.aamc.org/download/147312/data/table29-gradsraceeth0210_test-web.pdf pdf [Accessed: November 18, 2018]

[21] McMurray JE, Linzer M, Konrad TR, et al. The work lives of women physicians: Results from the physician work life study. *Journal of General Internal Medicine*. 2000;**15**:372-380

[22] Houle C, Harwood E, Watkins A, Baum KD. What women want from their physicians: A qualitative analysis. *Journal of Women's Health*. 2007;**16**:543-550

[23] Mast MS, Hall JA, Roter DL. Disentangling physician sex and physician communication style: Their effects on patient satisfaction in a virtual medical visit. *Patient Education and Counseling*. 2007;**68**:16-22

[24] Linzer M, Harwood E. Gendered expectations: Do they contribute to high burnout among female physicians. *Journal of General Internal Medicine*. 2018;**33**(6):963-965

[25] Saten SA, Holt DB, Jemp JD, Hemphill RR. Burnout in medical students: Examining the prevalence and associated factors. *Southern Medical Journal*. 2010;**103**(8):758-763

[26] IsHak W, Nikravesh R, Lederer S, et al. Burnout in medical students: A

systematic review. *The Clinical Teacher*. 2013;**10**(4):242-245

[27] Dyrbye LN, Thomas MR, Huntington JL, et al. Personal life events and medical student burnout: A multicenter study. *Academic Medicine*. 2006;**81**(4):374-384

[28] Lebares CC, Guvva EV, Ascher NL, et al. Burnout and stress among US surgery residents: Psychological distress and resilience. *Journal of the American College of Surgeons*. 2018;**226**(1):80-90

[29] Shanafelt TD, Bradley KA, Wipf JE, Back AL. Burnout and self-reported patient care in an internal medicine residency program. *Annals of Internal Medicine*. 2002;**136**(5):358-367

[30] Purdy RR, Lemkau JP, Rafferty JP, Rudisill JR. Resident physicians in family practise: Who's burned out and who knows. *Family Medicine*. 1987;**19**(3):203-208

[31] Nyssen AS, Hansez I, Baele P, et al. Occupational stress and burnout in anaesthesia. *British Journal of Anaesthesia*. 2003;**90**(3):333-337

[32] Baldwin PJ, Dodd M, Wrate RW. Young doctors' health: How do working conditions affect attitudes, health and performance. *Social Science & Medicine*. 1997;**45**:35-40

[33] Erez A, Judge TA. Relationship of core self evaluations to goal setting, motivation and performance. *The Journal of Applied Psychology*. 2001;**86**(6):1270-1279

[34] Milam LA, Cohen GL, Mueller C, Salles A. The Relationship Between Self-Efficacy and Well-Being Among Surgical Residents. *Journal of Surgical Education*. 2019;**76**(2):321-328

[35] Bosk CL. *Forgive and Remember: Managing Medical Failure*. 2nd ed.

Vol. 276. Chicago, IL: University of Chicago Press; 1979

[36] Luu S, Patel P, St-Martin L, et al. Waking up the next morning: Surgeons' emotional reactions to adverse events. *Medical Education*. 2012;**46**(12):1179-1188

[37] Lemaire JB, Wallace JE. Not all coping strategies are created equal: A mixed methods study exploring physicians' self report coping strategies. *BMC Health Services Research*. 2010;**10**(1):1

[38] Melamed S, Shirom A, Toker S, et al. Burnout and risk of cardiovascular disease: Evidence, possible causal paths, and promising research directions. *Psychological Bulletin*. 2006;**132**:327-353

[39] Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. *Annals of Surgery*. 2010;**251**(6):995-1000

[40] Shanafelt TD, Mungo M, Schmitgen J, et al. Longitudinal study evaluating the association between physician burnout and changes in professional work effort. *Mayo Clinic Proceedings*. 2016;**91**(4):422-431

[41] Dewa CS, Loong D, Bonato S, et al. How does burnout affect physician productivity? A systematic literature review. *BMC Health Services Research*. 2014;**14**:325

[42] Bianchi R, Boffy C, Hingray C, Truchot D, Laurent E. Comparative symptomatology of burnout and depression. *Journal of Health Psychology*. 2013;**18**(6):782-787

[43] Glass DC, McKnight JD, Valdimarsdottir H. Depression, burnout, and perceptions of control in hospital nurses. *Journal of Consulting and Clinical Psychology*. 1993;**61**(1):147

[44] Becker JL, Milad MP, Klock SC. Burnout, depression, and career

satisfaction: Cross-sectional study of obstetrics and gynecology residents. *American Journal of Obstetrics and Gynecology*. 2006;**195**(5):1444-1449

[45] Oreskovich MR, Kaups KL, Balch CM, Hanks JB, Satele D, Sloan J, et al. Prevalence of alcohol use disorders among American surgeons. *Archives of Surgery*. 2012;**147**(2):168-174

[46] Davis M, Detre T, Ford DE, Hansbrough W, Hendin H, Laszlo J, et al. Confronting depression and suicide in physicians: A consensus statement. *Journal of the American Medical Association*. 2003;**289**(23):3161-3166

[47] van der Heijden F, Dillingh G, Bakker A, Prins J. Suicidal thoughts among medical residents with burnout. *Archives of Suicide Research*. 2008;**12**(4):344-346

[48] Donaldson MS, Corrigan JM, Kohn LT, editors. *To Err is Human: Building a Safer Health System*. Washington, D.C.: National Academy Press; 2000

[49] Seys D, Wu AW, Gerven EV, Vleugels A, Euwema M, Panella M, et al. Health care professionals as second victims after adverse events: A systematic review. *Evaluation & The Health Professions*. 2013;**36**(2):135-162

[50] West CP, Huschka MM, Novotny PJ, Sloan JA, Kolars JC, Habermann TM, et al. Association of perceived medical errors with resident distress and empathy: A prospective longitudinal study. *Journal of the American Medical Association*. 2006;**296**(9):1071-1078

[51] Hayward RA, Hofer TP. Estimating hospital deaths due to medical errors: Preventability is in the eye of the reviewer. *Journal of the American Medical Association*. 2001;**286**(4):415-420

- [52] Brennan TA, Leape LL, Laird NM, Hebert L, Localio AR, Lawthers AG, et al. Incidence of adverse events and negligence in hospitalized patients: results of the Harvard Medical Practice Study I. *New England Journal of Medicine*. 1991;**324**(6):370-376
- [53] Hayward RA, McMahon LF, Bernard AM. Evaluating the care of general medicine inpatients: How good is implicit review? *Annals of Internal Medicine*. 1993;**118**(7):550-556
- [54] Williams ES, Manwell LB, Konrad TR, Linzer M. The relationship of organizational culture, stress, satisfaction, and burnout with physician-reported error and suboptimal patient care: Results from the MEMO study. *Health Care Management Review*. 2007;**32**(3):203-212
- [55] Firth-Cozens J, Greenhalgh J. Doctors' perceptions of the links between stress and lowered clinical care. *Social Science & Medicine*. 1997;**44**(7):1017-1022
- [56] Halbesleben JR, Rathert C. Linking physician burnout and patient outcomes: Exploring the dyadic relationship between physicians and patients. *Health Care Management Review*. 2008;**33**(1):29-39
- [57] Balch CM, Oreskovich MR, Dyrbye LN, Colaiano JM, Satele DV, Sloan JA, et al. Personal consequences of malpractice lawsuits on American surgeons. *Journal of the American College of Surgeons*. 2011;**213**(5):657-667
- [58] DiMatteo MR, Sherbourne CD, Hays RD, Ordway L, Kravitz RL, McGlynn EA, et al. Physicians' characteristics influence patients' adherence to medical treatment: Results from the Medical Outcomes Study. *Health Psychology*. 1993;**12**(2):93
- [59] Kushnir T, Greenberg D, Madjar N, Hadari I, Yermiahu Y, Bachner YG. Is burnout associated with referral rates among primary care physicians in community clinics? *Family Practice*. 2013;**31**(1):44-50
- [60] West CP, Dyrbye LN, Erwin PJ, et al. Interventions to prevent and reduce physician burnout: A systematic review and meta-analysis. *Lancet*. 2016;**388**:2272-2281
- [61] Shanafelt TD, Balch CM, Dyrbye LN, et al. Special report: Suicidal ideation among American surgeons. *Archives of Surgery*. 2011;**146**:54-62
- [62] Panagioti M et al. Controlled interventions to reduce burnout in physicians. *JAMA Internal Medicine*. 2017;**177**(2):195-205
- [63] Hutter MM, Kellogg KC, Ferguson CM, et al. The impact of the 80-hour resident workweek on surgical residents and attending surgeons. *Annals of Surgery*. 2006;**243**:864-875
- [64] Salles A, Nandagopal K, Walton G. Belonging: A simple, brief intervention decreases burnout. *Journal of the American College of Surgeons*. 2013;**217**:S116
- [65] Riall T, Teiman J, Chang M, et al. Maintaining the fire but avoiding burnout: Implementation and evaluation of a resident well-being program. *Journal of the American College of Surgeons*. 2018;**4**:369-379
- [66] Swensen S, Kabcenell A, Shanafelt T. Physician-organization collaboration reduces physician burnout and promotes engagement: The Mayo Clinic experience. *Journal of Healthcare Management*. 2016;**61**:105-127
- [67] Berry LL, Seltman KD. The enduring culture of Mayo Clinic. *Mayo Clinic Proceedings*. 2014;**89**(2):144-147
- [68] Dilling JA, Swensen SJ. Accelerating the use of best practices: The Mayo Clinic model of diffusion. *The Joint*

Commission Journal on Quality and Patient Safety. 2013;**39**(4):167-176

[69] National Academy of Medicine. Action collaborative on clinician well-being and Resilience. 2018. Available from: <https://nam.edu/initiatives/clinician-resilience-and-well-being>

[70] Shanafelt TD, Noseworthy JH. Executive leadership and physician well-being: Nine organizational strategies to promote engagement and reduce burnout. *Mayo Clin Proceedings*. 2017;**92**(1):129-146

IntechOpen