



# Can the practice of mindfulness reduce medical errors?

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## Abstract

**Purpose:** In this article we consider the impact of mindfulness as an effective method of coping with stress and review the available literature on this topic; in addition, we share our 5 years of experience working with final year medical students.

**Views:** Working in a hospital is a demanding and stressful job. Despite the rapid development of new technologies, the number of medical errors is not decreasing. In this paper we look for effective methods to improve medical education with a focus on the effects of stress on situational awareness (SA) and executive functions (EF). This study provides information on the beneficial effects of mindfulness techniques that, by influencing EF and SA, can directly reduce physicians' errors.

**Conclusions:** The authors of this paper contend that effective methods of coping with stress, including mindfulness, should be considered as an additional subject in the final years of medical education.

**Key words:** mindfulness, psychiatry, stress, situational awareness, executive functions.

## INTRODUCTION

Recently, the academic medical education community has drawn particular attention to the slightly increasing number of medical errors, which are mostly made by young physicians [1, 2]. Despite the increased access to medical knowledge and the use of gradually improved modern diagnostic techniques, the number of adverse events remains at a consistently high level. A possible explanation for this situation is the inadequate verification of information, especially by young physicians [3-6]. On the other hand, the direct cause of incorrect data processing may be excessive experience of stressful situations that occur in the early years of their work.

### The role of stress

Stress can have both enhancing and debilitating effects on the functioning of the body, especially on learning, remembering, maintaining concentration and focus [7]. A negative reaction to stress causes impaired concentration, which increases the risk of serious consequences, especially among physicians. This is often behind a failure to recognize significant symptoms, which is especially important when they threaten the lives of patients [8].

On the other hand, there are experienced physicians who, due to their experience and gradual, systematic integration of acquired knowledge, show greater attention and concentration [9]. By using certain patterns developed over the years, their patient presentations tend to be more comprehensive and accurate. This often results in fewer mistakes being made by experienced physicians [10]. Therefore, methods are sought to increase focus and concentration to compensate for the initial lack of experience in the group of young doctors. Due to the high emotional stress they experience in the early years of work, stress management techniques can be effective.

### Mindfulness as an effective method of coping with stress

Such method could reduce the negative impact of stress on the work of young doctors and thus reduce medical errors. One of the techniques for dealing with stress is mindfulness, which is the process of an individual intentionally focusing all their attention on the moment with curiosity, openness, and acceptance of each experience without judgment [11]. Mindfulness meditation reduces stress levels, positively affects executive functions (EF), and increases situational awareness (SA)

in practitioners. Therefore, we posed the following key questions: To what extent does the stress experienced by young doctors influence their practice? Is mindfulness an effective method of reducing anxiety levels, and does it improve situational awareness, thus reducing the number of mistakes made? And finally, can we use the knowledge gained by exploring these questions to improve medical education? So far, no one has taken up such a topic, and there is a small amount of data evaluating the impact of mindfulness from the perspective of medical education. Moreover, from the patient's point of view this is an extremely important issue, which can improve their safety and, as a result, reduce the financial consequences of possible medical errors.

## REVIEW OF PUBLISHED STUDIES

To answer the questions posed above, an analysis of published research papers has been conducted. In our search we have mainly focused on the effects of stress, mindfulness, situational awareness, and executive function on young physicians' decision-making.

## STRESS

Undoubtedly, an important aspect that plays a key role in managing our behavior is stress. It is a non-specific reaction of the body to any demands placed on it by the environment, which are associated with both pleasant and unpleasant events for the individual [12]. Whether stress mobilizes and helps us, or affects us negatively, depends on our ability to manage it. The point at which the level of stress experienced is disturbing and becomes pathological is an individualized factor that can be influenced by a variety of circumstances [13]. In addition to innate, natural mechanisms there are scientifically validated techniques for coping with stress, the learning of which can be effectively used by both patients and medical staff [14]. Both chronic, prolonged stress and temporary but highly intense stress cause noticeable physiological changes, during which hormone levels also change [7]. This is due to, among other things, the activation of the hypothalamic-pituitary-adrenal axis and the autonomic nervous system (ANS) [15]. This in turn has a direct impact on the functioning of the body. It improves its functioning, by increasing metabolic activity, or weakens it when defense mechanisms become exhausted.

### The impact of stress on medical staff

The professional groups that enjoy public trust are particularly exposed to the negative effects of stress, including physicians who work in an intense, chaotic and unpredictable environment [16]. During their work in a hospital they are forced to make quick and important decisions that are

always accompanied by stress, which through biological effects also indirectly affects the EF this mainly concerns attention and memory. Lack of attention increases the risk of serious consequences such as medical errors, failure to recognize life-threatening signs and symptoms, and other important patient safety issues [8].

## Coping strategies

According to Lazarus and Folkman's relational theory, coping with stress involves an individual's ever-changing cognitive and behavioral effort to control specific demands that are judged to be a burden or exceed their resources [17]. Effective coping, which is expressed in a good match between demands and opportunities, reduces the state of stress. In contrast, ineffective coping leads to an increase in stress. The literature presenting the issue of coping with stress distinguishes three concepts with which to describe this phenomenon. These are: process, strategy and style. The process of coping with stress is a sequence of strategies that change over time, but is also genetically determined. Of particular relevance among physicians, problem-focused coping seems to describe an action-oriented style of coping with stress. Such individuals focus on a task or the planning of a solution to a problem. The style of coping with stress is on the one hand genetically determined, while on the other it is possible to some extent to modify abnormal mechanisms and reactions. Identification of the stress coping styles used among medical students is particularly important, as this is the right time to possibly work on reactions and behaviors. This is an extremely important aspect of medical education, which, in addition to the substantive knowledge of future doctors, can benefit both specific individuals and society as a whole. Therefore, timely education on methods of coping with stress is particularly important in this case.

## MINDFULNESS

Due to the accelerating pace of work and increasing number of stimuli, to which people are now subjected it is observed that in general the quality of mental life decreases [18]. This leads to an increase in the incidence of depression, the emergence of burnout syndrome and decline in empathy and ethical reasoning, which becomes apparent even during the early years of work [19]. This concerns physicians, academics, students and other non-medical staff. In response to this phenomenon, effective relaxation methods are being sought.

### What is mindfulness?

Mindfulness practice is one of the effective methods used by health care professionals to reduce stress. Mindfulness is a skill in which a person is directly focusing on

a particular moment or a particular issue, and approaches it with openness and acceptance [20]. The practice of mindfulness leads to a conscious response to difficult situations, turning off negative automatisms. So mindfulness is consistent with the primary goal of medical practice: to treat illness when possible and to manage suffering in a compassionate way.

### The impact of mindfulness on medical staff

In a study involving medical students, it was shown that being mindful is directly related to the reduction of stress and anxiety. In addition, it improves mood and increases empathy levels [21]. This is also supported by a meta-analysis involving 19 studies on the use of mindfulness among medical students [22]. Thus, mindfulness training appears to be an effective way to reduce stress among healthcare professionals [23]. It is a very important skill in coping with daily functioning in a hospital environment [24]. In addition, mindfulness can increase the ability to detect and correct one's own mistakes, which considering the number of difficult decisions to be made is extremely important. The ability to experience without judging can also improve collaboration in medical teams and thus improve the performance of those teams in which it is practiced. Communication errors in medical teams are a common cause of subsequent medical errors [25]. The mitigating effects of practicing mindfulness may be particularly useful in the early years of practice, when young physicians are particularly exposed to a multitude of new stimuli and the resulting severe stress. On the other hand, there are also studies that do not support the effectiveness of mindfulness in reducing mental stress among college students, due to the existence of inconsistent reports regarding the use of the Maslach Burnout Inventory (MBI) and in response to appeals from other authors [26].

## SITUATIONAL AWARENESS

### The importance of situational awareness among medical staff

Clinical reasoning, which requires identifying the basic elements of SA, is extremely important in the initial stages of working with patients. Recent and emerging research suggests that medical students have little insight into cognitive processing and SA [27]. Furthermore, SA is identified as one of the critical elements influencing medical practice [28], while the WHO has classified inadequate SA as a core parameter influencing inadequate clinical performance [29]. Situational awareness is the perception of individual elements of the environment with respect to the time and space in which they are located and their projection into the future. It belongs to the set of mechanisms via which we make de-

isions, thus conditioning purposeful, effective action. Loss of SA often occurs in situations where we experience unexpected, severe stress. Such moments are often experienced by medical professionals when treating critically ill patients [30]. Due to the lack of a universally accepted method, assessing situational awareness in medicine is extremely difficult. Fisher *et al.*, reviewing the literature on the subject, suggest the use of Objective Structured Clinical Examinations (OSCEs) to assess individual elements of SA [31]. This is done through the use of medical simulations involving a holistic assessment of the student's clinical management relative to a case. To improve the clinical performance of young physicians and reduce medical errors, strengthening SA should be a key element [32, 33]. Moreover, SA should be reinforced as early as possible in the patient workflow, especially during medical education. Given the particular exposure to such situations among physicians, the question arises as to how to improve SA so that the stress of treating patients does not negatively affect young physicians.

### Mindfulness as a method for improving situational awareness

Therefore, it is worthwhile to look for methods to improve SA and reduce stress. This is especially important among young physicians when the intensity of new stressful situations is strongest. The small number of studies conducted to date suggest that mindfulness practice is partially related to SA. It is primarily related to the taking of information during the case history, physical examination and the interpretation of additional tests. This is the first stage of a patient's treatment, where mindfulness is especially needed. In addition, the authors have shown that mindfulness is associated with certain non-technical skills in medical students, i.e., avoiding fixation-error during pediatric emergency simulations [34]. This evidence suggests that mindfulness can enhance medical students' ability to focus and concentrate by increasing present-moment awareness in pediatric emergencies [35]. Mindfulness practice appears to be a potentially effective method for improving SA, thereby reducing the number of medical errors. However, further research is required, specifically examining SA before and after an intervention such as mindfulness.

## EXECUTIVE FUNCTIONS

### The importance of executive functions among medical staff

Executive functions are a set of specific processes that are responsible for directing, managing, and initiating specific behaviors. They are especially important while

dealing with new and difficult situations that involve unexpected stress [36]. Research has shown that executive functions may be related to cognitive thinking, which is essential for proper clinical management by physicians. Studies on health care workers have found that occupational burnout is associated with EF impairments, particularly in inhibition, working memory, and decision making [37]. EF impairment makes it difficult to cope with new situations, causes difficulty in focusing attention [38], consequently reduce the productivity of medical workers [39, 40], and leads to potential medical errors. On the other hand, well-developed executive functions ensure effective planning, goal setting, the flexible changing of action strategies, and efficient problem solving. They are also responsible for non-technical skills. These are skills that facilitate effective communication with patients. Research reports have shown that implementation of non-technical skills (NTS) was associated with noticeable improvements in clinical outcomes. Study participants reported increased confidence in dealing with the deteriorating clinical conditions of patients [41]. There have also been numerous scientific calls for the introduction of NTS teaching to the medical school curriculum with the aim of, among other things, improving team communication and consequently reducing medical errors [42].

### Mindfulness as a method for improving executive functions

Therefore, effective ways of improving EF are being sought, thereby increasing non-technical skills [43] among young physicians and medical students. Practicing mindfulness by improving non-technical skills [44] leads to increased professionalism among students and young doctors. Moreover, it improves awareness of one's own limitations, facilitates prioritization, and thus enables effective help-seeking when needed [45]. Previously published studies have demonstrated that mindfulness meditation has led to improved executive functioning and increased levels of critical thinking [46].

## DEPARTMENT OF MEDICAL SIMULATIONS PROJECT

In addition, we share here our experience of teaching the 6<sup>th</sup> (final) year medical students from 2017 to 2021. During high-fidelity simulations more than 600 students played the role of an attending physician at least once in each of the 2 semesters. During the classes at the Department of Medical Simulations, students had the opportunity to play the role of a doctor for the first time, fully on their own. They had to independently make decisions about the diagnosis and treatment of the patient. Over the years, we analyzed the impact of mindfulness, execu-

tive functions, and stress on the therapeutic outcomes they achieved.

## CONCLUSIONS FROM OUR EXPERIENCE

Conclusions from our study describe the effects of stress, mindfulness and executive function on the behavior and skills displayed by students during the simulation. In our study, stress was milder and more motivating the more attentive the students were. Students' mindfulness correlated positively with avoidance of fixation error [47]. In addition, the non-technical skills of the student group leaders improved with each simulation, while technical skills remained at the same level. We also noted that lack of reactivity, a component of mindfulness, was related to accurate collection of patient data from the medical history [48].

## THE OBJECTIVE STRUCTURED CLINICAL EXAMS PROJECT

In addition, there has been a recent change in medical exams; in addition to the typical theoretical knowledge, medical students are evaluated on their performance in practice. This uses more realistic, structured methods such as Objective Structured Clinical Exams (OSCE) [49]. Moreover, during such examinations other essential physician characteristics such as patient communication skills, student professionalism, and situational awareness are assessed. There are studies that confirm the potential of OSCE as an effective didactic method of improving SA during medical education [50-53]. In our center, we plan to continue research on the effects of mindfulness, stress, situational awareness and executive functions on the basis of the results achieved during these exams.

## DISCUSSION

Mindfulness has been presented here as one of the effective methods of coping with stress. The beneficial effects of mindfulness techniques affect EF and SA, which can directly reduce medical errors.

The authors emphasize that SA is a key component of effective clinical intervention, especially in the early years of practice. Effective methods for improving SA include practicing mindfulness, which results in fewer errors. Another important aspect is EF – specific qualities that support effective action and decision-making. They are particularly important in NTS, the teaching of which is undeniably needed. Mindfulness practice can serve to educate NTS, thereby influencing EF and SA, which can often be sources of medical errors.

The aforementioned aspects are extremely important factors affecting the way physicians function in their pro-

fessional lives. This is especially important and worthy of attention among young people during their education. Paying attention to these often overlooked issues during medical education could have a measurable impact on medical staff and, consequently, on their future patients. By learning to cope with stress, improving situational awareness and executive function, the frequency of an individual's errors can be reduced.

The paper presents high-fidelity medical simulation as a modern way of teaching that not only enhances content knowledge, but also prepares students for the specific stressors they are sure to experience in their careers. Simulation centers could become a place for medical students to learn mindfulness techniques, to consciously recognize the space between stimulus and response, and to respond to triggers, especially high-stress ones. Simulation scenarios include technical skills, such as diagnostic and therapeutic procedures, and non-technical skills. Therefore, high-fidelity simulation should be used to teach virtually all aspects of emergency care. In addition to this, high-fidelity simulations are an increasingly common method of teaching NTS. Learning to practice mindfulness techniques, on the other hand, provides a tool for distancing oneself from a stressful work environment, which can positively affect objective assessment of a clinical situation.

The above conclusions are supported by both our experience and the studies available in the literature. In one such study by Marker *et al.*, as in our group, repetition of the simulation improved non-technical skills such as communication, teamwork, situational awareness and decision-making [51]. Clarke *et al.* showed, however, that the only variable affecting the overall rating of non-technical skills during the simulation (assessed with the GRS Ottawa) was the physicians' clinical experience, not stress or its subjective perception [52]. This can be explained because stress management skills, SA or EF were not included in this study. As the authors of the study showed, mindfulness training can be adapted and incorporated into modern medical teaching with relative ease. Focusing on the present moment can help young doctors hone in on what is really important, which can include helping patients as well as themselves. The goal of mindfulness is

to enable health care professionals to maintain distance from a mentally and emotionally stressful environment. Mistakes of fixation lead to adverse events; therefore, highly developed degree of SA among emergency medical teams leads to the avoidance of fixation errors and the correct diagnosis and treatment [53].

Considering the practice of mindfulness in medical education and the daily work of doctors, it is also very important to be aware of potential problems and risks. First of all, when teaching mindfulness techniques in medical school, attention should be paid to aspects such as the individual experience of stress, and students' situational awareness and executive functions. It should be noted that there is a risk of increased stress, in some students who are predisposed to it, in the early stages of mindfulness practice. Individuals who gain greater self-awareness during such practice may become too focused on their own experiences and become overly controlling, which may end up with job burnout greater than without mindfulness. Second, attention should be paid to the technical aspect of teaching mindfulness. It is extremely important to use validated, accurate mindfulness questionnaires [27]. Another important point is that a mindfulness instructor should be certified and continually expand his or her competence in certified centers. However, it should be emphasized that in addition to mindfulness, there are other methods that are also effective in dealing with stress.

## CONCLUSIONS

To summarize the current scientific reports mentioned above and our own experience, mindfulness is an effective stress reduction technique that can improve SA and EF. Further multicenter studies in this area may show whether this will translate into fewer medical errors. The search for new teaching techniques is widening. Effective teaching methods include Medical Simulation Centers and OSCE exams. In the opinion of the authors of this publication, teaching mindfulness techniques as an optional subject in medical studies should be considered, and thus further research based on the results and opinions of students should be undertaken.

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### Conflict of interest

Absent.

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