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Student wellness trends and interventions in medical education: a narrative review

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Medical education is a time wrought with personal and professional stressors, posing serious challenges to maintaining student wellness. Extensive research has thus been conducted to identify these stressors and develop practical solutions to alleviate their harmful effects. This narrative review of quantitative and qualitative literature summarizes trends in student wellness and examines interventions deployed by medical schools to ameliorate student distress. Current trends indicate that mental illness, substance use, and burnout are more prevalent in medical students compared to the general population due to excessive academic, personal, and societal stressors. Pass/fail grading systems and longitudinal, collaborative learning approaches with peer support appear to be protective for student wellness. Additionally, maintaining enjoyable hobbies, cultivating social support networks, and developing resiliency decrease distress in medical students on an individual level. Faculty and administrator development is also a necessary component to ensuring student wellness. The COVID-19 pandemic has posed unique challenges to the medical education system and has stimulated unprecedented innovation in educational technology and adaptability. Particularly, the discontinuation of the clinical skill evaluation components for both osteopathic and allopathic students should be a focus of medical student wellness research in the future.

Defining student wellness

Defining student wellness has challenged stakeholders throughout the medical education system. The term "wellness" first appeared in literature following World War II, though the concept extends back to Christian ethics of the 19th century that linked physical well-being to moral character (Kirkland, 2014). Implicit within these origins of wellness is a responsibility of the individual to contribute to their own well-being. This is reflected in Kirkland's premise that "each individual can and should strive to achieve a state of optimal functioning" (2014). Contemporary researchers characterize wellness similarly to the World Health Organization's (WHO) definition of human health. In the preamble to the WHO's constitution, health is defined as a "state of complete physical, mental, and social well-being and not merely the absence of disease" (Grad, 2002). Wellness can therefore be succinctly defined as self-aware, intentional prevention of distress and promotion of well-being (Kirkland, 2014).

Human wellness's inherent multidimensionality often poses a challenge to quantitative research methods. Most studies thus ultimately measure some combination of indicators for distress and well-being. Addiction, mental disorders, suicidal ideation, and burnout are common

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indicators of distress assessed through various screening methods (Jackson et al., 2016; Moir et al., 2018; Dyrbye and Shanafelt, 2016). On the contrary, Gallup-Healthways Well-Being Index Composite Score examines well-being across several domains of life, including: life evaluation, emotional health, physical health, healthy behavior, work environment, and basic access. The Well-Being Composite Score thus emphasizes the presence of health rather than absence of disease (Kirkland, 2014). Though methodologies and definitions vary across studies and reviews, the fundamental characteristics of wellness appear constant: absence of disease and presence of health. Investigations using this paradigm have identified professional education, particularly medical education, as a time of increased distress and diminished wellness (Dyrbye et al., 2014). We have thus undertaken a review of contemporary literature to identify trends in student wellness, as well as the interventions deployed to address such trends. This narrative review outlines the prevalence and contributing factors to mental illness, addiction, and burnout in the medical student population. We then describe several intervention strategies used by medical schools to address student wellness deficits, including: wellness committees, pass-fail (P/F) grading, mindfulness training, curricular alterations, and developing more wellness-aware faculty/administration. In compiling this review, we hope to provide a snapshot of contemporary student wellness that may be used to guide medical schools seeking to improve the student experience during the COVID-19 pandemic and its aftermath.

Mental well-being

As previously mentioned, directly measuring wellness is a challenge in educational research. Therefore, most studies assess wellness of student populations by examining rates of mental illness or distress (Kirkland, 2014). Numerous studies have revealed that mental health issues are virtually ubiquitous in the medical education system. Dyrbye and colleagues report that medical school appears to be a peak time for distress in a physician's training (2014). Localization of distress to the training process is evidenced by higher rates of depression, fatigue, and suicidal ideation in medical students as compared to age-matched controls from the general population, with these symptoms declining to the same levels as control populations within 5 years after completing post-graduate education (Dyrbye et al., 2014). Further, Jackson et al determined that a majority of medical students exhibited either burnout, depressive symptoms, suicidal ideation, alcohol abuse/dependence, or a combination of these factors at the time of survey (2016). A meta-analysis conducted by Rosenstein and colleagues revealed that 27% of medical students met criteria specifically for depression or depressive symptoms (2016). This increased prevalence of mental illness is not restricted to medical education. A survey of law students revealed that 17% screened positively for depression, 37% screened positively for anxiety, and 27% screened positively for an eating disorder. These statistics indicate increasing trends of mental illness across graduate education as a whole, rather than medical education alone (Organ et al., 2016).

This prolific mental distress can substantially impact medical students' ability to meet academic demands (Dyrbye et al., 2014). As such, substantial research has been conducted investigating factors that contribute to mental illness in an academic setting. Surprisingly, students begin medical school with mental health better than similarly aged peers. However, these roles quickly reverse, with medical student mental health ultimately becoming worse than control populations (Dyrbye and Shanafelt, 2016). It seems that medical education may actually select for individuals prone to developing psychological distress (Bergmann et al., 2019). Moir et al. report that the majority of medical students are considered Type A individuals, displaying high levels of ambition and competition. Though these qualities facilitate academic success, they also lead to hostility and frustration with challenging situations (Moir et al., 2018). Medical students were also found to have high levels of conscientiousness (Moir et al., 2018). Conscientiousness is a component of the Big 5 Personality model, which uses the qualities of neuroticism, extraversion, openness, agreeableness, and conscientiousness as the most basic descriptors of an individual's personality (Shi et al., 2018). Conscientiousness is characterized by diligence and careful attention to detail, thus predicting high levels of academic success. However, increased conscientiousness may also exacerbate the likelihood of mental and physical distress due to inordinate demands placed on one's self (Bergmann et al., 2019). Student age was also found to correlate with mental well-being. Younger students were found to approach their studies with dualistic orientations, seeking an explicit, incontrovertible knowledge of medicine. Diagnostic challenges and knowledge gaps ubiquitous in clinical medicine can thus be frustrating to younger students (Lonka et al., 2008). It is worth noting that, despite the importance of addressing mental health issues, some authors feel categorizing symptoms of depression and burnout leads to over-medicalization of human suffering and is not useful (Moir et al., 2018).

The aforementioned qualities of medical students facilitate development of both maladaptive perfectionism and imposter syndrome, heightening mental wellness concerns in this population (Bubenius and Harendza, 2019; Hu et al., 2019; Henning et al., 1998; Seeliger and Harendza, 2017; Thomas and Bigatti, 2020). The prevalence of imposter syndrome has been estimated between 22.5–46.6% in medical students, however, the prevalence of perfectionism has proven much more difficult to measure (Thomas and Bigatti, 2020). Maladaptive perfectionism is a multifactorial entity encompassing inordinate self-expectations, negative reactions to failure, and a persistent lack of satisfaction in performance (Bubenius and Harendza, 2019; Thomas and Bigatti, 2020). This emphasis on perfection prevents students from appreciating their vulnerability and thus delays self-recognition of mental distress (Seeliger and Harendza, 2017). Not surprisingly, maladaptive perfectionism has thus demonstrated an association with anxiety, depression, bulimia nervosa, anorexia nervosa, and chronic fatigue syndrome (Thomas and Bigatti, 2020). The strength of these associations was further demonstrated by Bubenius and Harendza's use of maladaptive perfectionism as a predictor of depressive symptoms in German medical school applicants (2019). Imposter syndrome is a phenomenon often associated with maladaptive perfectionism and is characterized by anxiety, lack of self-confidence, depression, and frustration with one's performance (Clance and Imes, 1978). While imposter syndrome bears an uncanny resemblance to perfectionism, the difference lies in imposter syndrome's characteristic fear of being discovered as undeserving of a place in medical school, regardless of actual accomplishments (Clance and Imes, 1978). Imposter syndrome has been associated with a lack of resilience and this, similar to perfectionism, can increase psychological distress (Levant et al., 2020). The combined effects of imposter syndrome and maladaptive perfectionism predispose students to mental health issues and thus deserve special attention in studies geared toward well-being interventions. Of note, preliminary work by Chand and colleagues has demonstrated that cognitive behavioral therapy may be especially effective in ameliorating the deleterious effects of maladaptive perfectionism (Chand et al., 2018). Treatment for imposter syndrome, however, appears to be a significant gap in wellness literature (Bravata et al., 2020).

Deeply intertwined with imposterism and perfectionism is the medical student's experience of shame. Shame is characterized as a negative emotional response to life events. These life events can take

many forms, though personal mistakes within a hostile environment are a common instigator of shame (Bynum et al., 2019). Perfectionism and imposter syndrome thus provide a fertile soil of negative self-evaluation in which shame can flourish (Bynum et al., 2020). Feelings of shame are further exacerbated by factors within the medical school environment. Mistreatment by colleagues or preceptors, receiving low test scores, underrepresentation within classes, institutional expectations, and social comparison were reported as contributors to shame by medical students in a hermeneutic analysis (Bynum et al., 2021). Regardless of origin, shame has been recognized as a "destabilizing emotion," leading to student isolation, psychological distress, and difficulty with identity formation (Bynum et al., 2021). Explorations of shame as a contributor to medical student distress are limited in the current literature. Thus, wellness researchers must dedicate studies to characterizing and preventing this significant, but potentially modifiable, contributor to student distress (Bynum et al., 2019).

Medical students' educational environment can also have a profound impact on mental health, particularly during the early days of training. The transition between college and professional school is marked by anxiety, stress, and financial upheaval. Thus, students may feel more vulnerable than ever as they begin their professional education in a new environment in which they are unaware of available mental health resources, leading to isolation and unnecessary suffering (Organ et al., 2016). Even for those aware of these resources, significant stigma still surrounds mental illness in professional education. This is emphasized in Organ et al's finding that only 50% of law students with mental health issues actually receive professional counseling. Their findings suggest that this reluctance largely stems from fear of professional repercussions if administrators discover a student's mental health diagnosis (Organ et al., 2016). While this study was conducted in law students, Hankir et al found similar trends in both medical students and physicians by examining autobiographical narratives published to combat the stigma against help-seeking behavior (Hankir et al., 2014). Hankir and colleagues have elucidated several phenomena that contribute to medical students delaying or even avoiding treatment for mental distress. Self-stigma operates as a powerful deterrent to help-seeking and seems to stem from internalization of society's expectation that medical students are mentally and physically invincible. This leads to feelings of decreased self-esteem and self-efficacy, as well as fear of stigmatization from the general public (Hankir et al., 2014; Fischbein and Bonfine, 2019). Rahael Gupta, now a psychiatry resident, brought this stigma to public light as she shared her personal experience with depression during medical school in her short film project entitled "Physicians Connected." The film, conveyed line-by-line through Gupta's colleagues at the University of Michigan, highlights the unspoken rule that mental distress is a black mark on a future physician's career (Gupta, 2018). Gupta's efforts, and those similar, underscore a growing call for public discourse, rather than concealment, of mental well-being within the medical profession. This call is echoed with Robyn Symon's film "Do No Harm: Exposing the Hippocratic Hoax," which further explores the toxic culture of medical education that drives physicians and medical students to commit suicide. Both Gupta and Symon highlight the taboo of mental distress within the medical field, which instead prioritizes efficiency and academic success over student and physician well-being. Both films characterize this lack of help-seeking behavior as products of the healthcare system's toxic structure, rather than individual student distress interacting with a demanding work life (Gupta, 2018; Symon 2020).

Substance use

In addition to impaired academic performance, mental illness also increases risk for development of substance use disorder in medical students (McLellan, 2017). Thus, the pervasiveness of mental illness during medical education warrants careful analysis of substance use patterns in the student population. Alcohol abuse or dependence has already been well documented in the professional education system (Dyrbye and Shanafelt, 2016; Organ et al., 2016; Jackson et al., 2016). Alarmingly, despite 43% of law students reporting a recent occurrence of binge drinking, only 4% had sought professional assistance for alcohol or drug misuse. This trend again highlights significant mental health and addiction stigma throughout the graduate education system (Organ et al., 2016). Medical students, and all those in the medical field, may be uniquely affected by this prevalence of substance use. For example, the American Foundation for Suicide Prevention produced a documentary entitled "Struggling in Silence: Physician Depression and Suicide," which highlights the powerful role that substance use plays in medical student and physician suicide specifically. With a greater knowledge of and access to potentially lethal substances, those in the medical field are at heightened risk for suicide completion, especially with the inhibition-lowering effects of some drugs (AFSP, 2002).

Alcohol dependence is of particular concern in medical education due to implications in hindering student career progression and compromised patient safety. Despite this concern, alcohol use is prevalent among medical students. A survey of 855 medical students across 49 schools in the United States revealed that 33.8% of students reported consuming 5 or more drinks in one sitting within the past two weeks, meeting the criteria for binge drinking (Ayala et al., 2017). Further, survey responses from 4402 medical students in the U.S. demonstrated that 32.4% met criteria for alcohol abuse/dependence, compared to 15.6% in a control sample of similarly aged but non-medical student counterparts (Jackson et al., 2016). The substantial academic stress of a professional education is a clear driving force behind this trend, though several compounding risk factors have been identified. Young males were identified as at an increased risk for alcohol dependence compared to their female colleagues (Jackson et al., 2016; Organ et al., 2016). Jackson and colleagues further identified that students who were unmarried, diagnosed with a mood disorder, low-income, or burdened with educational debt from professional and undergraduate studies were at increased risk for alcohol dependence (2016). While ethnicity's relationship to alcohol use was not explored in medical students, a survey of over 11,000 law students from 15 law schools in 2016 determined that ethnic minorities were more likely to report an increase in drinking whereas Caucasian students were more likely to demonstrate a positive CAGE screening (Organ et al., 2016). The CAGE screen is a 4-item questionnaire developed by John Ewing in 1984 to identify drinking problems. The CAGE screen has a 93% sensitivity and 76% specificity for identifying problem drinking whereas alcoholism identification has a sensitivity of 91% and specificity of 77% (Williams, 2014). This increased alcohol use in both Caucasian and ethnic minority students demonstrates a need for culturally tailored and inclusive prevention programs.

Though alcohol is the most commonly abused drug amongst medical students, illicit drug use has also been reported at concerning levels. A survey of 36 United States medical schools revealed that approximately one-third of students had used illicit drugs within the past 12 months (Shah et al., 2009). Papazisis and colleagues similarly examined illicit drug use in undergraduate medical students in Greece, finding a lifetime substance use rate of ~25% (2017). Marijuana was the most common illicit drug used in both studies (Shah et al., 2009; Papazisis et al., 2017). Use of prescription medications without a prescription was also found amongst law students, particularly stimulants such as Ritalin, Adderall, and Concerta (Organ et al., 2016). These findings

suggest that the competitive culture of graduate education may drive students to engage in recreational drug use, particularly those struggling to meet academic demands or suffering from mental distress.

Student burnout

Burnout was canonically defined by Freudenberger in 1974 as a state of physical and mental exhaustion caused by or related to work activities, often manifesting when heightened professional stress conflicts with personal ideals or expectations (Freudenberger, 1974; Rodrigues et al., 2018; Baro Vila et al., 2022). Though originally a descriptive disorder, burnout is now recognized in the International Classification of Diseases, 10th revision, under code Z73.0 (Lacy and Chan, 2018). Burnout is traditionally diagnosed with the Maslach Burnout Inventory, a 22-item questionnaire that characterizes each of the three burnout domains: emotional exhaustion, depersonalization, and personal accomplishment (Dyrbye and Shanafelt, 2016). Emotional exhaustion is associated with feelings of being overworked and a subsequent loss of compassion. Depersonalization is characterized by a sense of detachment from colleagues/patients and, when combined with emotional exhaustion, can result in unprofessional behavior. The personal accomplishment domain mainly describes an individual's feelings of competence and professional satisfaction (Lacy and Chan, 2018). In addition to each domain's unique consequences, burnout domains interact to cause an extinction of motivation when efforts no longer produce desired results (Vidhukumar and Hamza, 2020). Approximately 50% of fourth year medical students were found to have burnout when surveyed with the Maslach Burnout Inventory (Dyrbye and Shanafelt, 2016). This value holds true internationally according to a survey of medical students conducted in India (Vidhukumar and Hamza, 2020). Additionally, burnout increases as training progresses, particularly the depersonalization component (Dyrbye and Shanafelt, 2016). Burnout thus increases feelings of callousness towards patients, leading to unprofessional and potentially dangerous conduct. Burnout in medical school also appears to affect specialty choice; burned out individuals were more likely to choose specialties with more controllable lifestyles and higher pay (Dyrbye and Shanafelt, 2016). Investigating causes of burnout is thus of utmost importance to understand potential influences on medical student career trajectory and ensuring patient safety.

Identified causes of burnout appear to differ between the years of medical training. Preclinical years are characterized by dissatisfaction with the learning environment and lack of faculty support. Clinical years are characterized by dissatisfaction with the learning environment, clerkship disorganization, and working with cynical or abusive residents and/or attending physicians (Dyrbye and Shanafelt, 2016). Reed and colleagues found a positive correlation between the time spent in exams and burnout whereas a negative correlation was observed with increased patient interaction (2011). Several correlates of burnout outside of medical schools' learning environments and curricula have also been described, including: female gender, dissatisfaction with career options, non-ethnic minority status, high educational debt, residency competition, expanding knowledge-base, workforce shortage, and stressful events in one's personal life (Dyrbyre and Shanafelt, 2016; Vidhukumar and Hamza, 2020). Erosion of social ties during medical education also contributes to the burnout spiral, as socialization is protective against burnout symptoms (Bergmann et al., 2019; Busireddy et al., 2017). No associations between contact days, time in didactic learning or clinical experiences, and any measure of student well-being and burnout prevalence were found (Reed et al., 2011).

Interventions to improve well-being

Medical schools have implemented several interventions to reduce student distress and enhance wellness. Though interventional approaches are varied, researchers have identified salient features common to most successful wellness interventions. For example, Dyrbye and colleagues underline the importance of well-being committees that can liaise between administration, faculty, and students, lessening fear of admonishment for seeking help or acknowledging distress (2019). Additionally, Moir et al reports that student buy-in is absolutely essential, as disengaged wellness lectures offer little, if any, benefit (2016). Interventions appear most effective when they are designed to reduce student burdens, rather than adding to the already overwhelming schedule and content of medical school (Busireddy et al., 2017). Finally, administrations often pose an obstacle to wellness initiatives, especially those who believe that well-being is of minor importance. This obstacle is reflected by the low prevalence of medical schools with official wellness competencies built into the curriculum (Dyrbye et al., 2019). We will now explore some of the specific interventions medical schools have employed to improve student wellness.

Transitioning to a Pass/Fail (P/F) grading scheme is a wellness initiative that has received substantial attention in the United States, especially in light of findings that grade evaluation systems are a larger determinant of student well-being compared to content of educational contact hours (Reed et al., 2011; Spring et al., 2011). The Mayo Medical School examined the feasibility and effects of P/F grading by introducing the system to first-year medical students in 2006. Rohe and colleagues found that these first-year medical students reported less stress, better overall mood, and greater group cohesion compared to their graded peers. These characteristics persisted into the second year of medical school, even when grading reverted to a traditional 5-level schema (Rohe et al., 2006). While critics of P/F grading argue that students will be less motivated to excel academically, evidence suggests that first-year residents from P/F schools performed similarly to residents from graded schools (Rohe et al., 2006). Additionally, a P/F system reduces extrinsic motivation and intense competition while increasing cohesion and peer cooperation (Moir et al., 2018; Rohe et al., 2006). These qualities are essential in the increasingly team-based healthcare landscape. Though transitioning to a P/F system reduced medical student distress during the preclinical years, it is important to note that the transition did not decrease test anxiety for the United States Medical Licensing Exam (USMLE) Step 1 (Williams et al., 2015; Rohe et al., 2006). Determining test anxiety for USMLE Step 1 will be an active area of research in the face of a new P/F grading for the licensure exam.

Allopathic and osteopathic medical programs are infamous for their academic rigors and intense curricular designs. These curricula are often described as competitive, leisure and socialization-deficient, and requiring exclusive dedication. These characteristics predispose medical students to decreased quality of life (Bergmann et al., 2019). As such, altering the curricula of these programs has been investigated as a means to prevent, rather than react to, student distress through a person-in-context perspective (Dyrbye et al., 2005; Slavin et al., 2012; Slavin et al., 2014). It has long been documented that the undergraduate medical curriculum is overflowing with information (D'Eon and Crawford, 2005). Rather than identifying salient features for inclusion in courses, medical school faculty often address this surplus of information by cramming unrealistic amounts of information into lectures (D'Eon and Crawford, 2005; Dyrbye et al., 2005). As mentioned earlier, wellness initiatives are often more effective when they reduce student burdens, rather than adding additional requirements (Busireddy et al., 2017). Though

this may lead one to believe that shortening curricular hours is an intuitive wellness initiative, this measure only led to workload compression and feelings of being unprepared for clinical practice when used as a unifocal intervention (Dyrbye and Shanafelt 2016; Busireddy et al., 2017; Dyrbye et al., 2019). This continually expanding mass of information thus poses two challenges to wellness initiatives. First, medical students' schedules are often too consumed by curricular hours to engage in additional wellness programming, especially without an external motivator. Second, the amount of information itself imposes feelings of distress on students, exacerbating the already-stressful nature of medical school and predisposition to mental health issues. Beyond the quantity of curricular hours, delivery and content of those hours is also important to student wellness. Lonka and colleagues found that a collaborative approach to learning increased satisfaction and decreased the perceived workload (2008). The collaborative environment of problem-based learning may thus offer some improvement to curriculum-induced stress, though current evidence is weak (Camp et al., 1994). Incorporating self-care workshops into the curriculum also appears to ameliorate the depersonalization component of burnout (Busireddy et al., 2017). In light of these promising results, it follows that the most powerful approach to improving student wellness through curricular restructuring is a multifactorial one. This multifactorial approach is best appreciated in the wellness initiatives within the Vanderbilt University School of Medicine and the Saint Louis University School of Medicine (Drolet and Rodgers, 2010; Slavin et al., 2014).

The Vanderbilt wellness initiative is composed of three arms: the Advisory College System, the Student Wellness Committee, and Vanderbilt Medical Student LIVE. The Advisory College is composed of both students and faculty that offer personalized advising and mentorship to students within the school. The Student Wellness Committee emphasizes student-led wellness initiatives and serves as an interface with faculty. Lastly, Vanderbilt Medical Student LIVE is an adjunct curriculum that fosters self-care and personal growth amongst the physicians in training (Drolet and Rodgers, 2010). The wellness program at the Saint Louis University School of Medicine is structured differently, though shares similar goals. The program entitled Mental Health 3.0 radically, but feasibly and efficiently, altered the structure of the School's curriculum. Grading was converted to a P/F basis, with only the median exam score and 75th percentile reported to students. Student contact hours were reduced by 10% during the preclinical curriculum and faculty were advised on how to appropriately identify topics for inclusion in their lectures. Longitudinal electives were instituted following contact hour reduction to encourage student growth and interest identification while forming relationships with fellow students and faculty. These electives were complemented by the formation of five learning communities to further enhance student immersion in areas of interest. Lastly, resilience and mindfulness training was incorporated into the mandatory curriculum while offering an increased number of social events (Slavin et al., 2014; Slavin, 2019). This wellness initiative was continually expanded and improved to include an early entry and exit to third-year clinical rotations, which minimized stress entering fourth year, and a confidential depression/anxiety tracking system to screen students for worrisome mental health issues (Slavin and Chibnall, 2016; Slavin, 2019). Comparison between these wellness initiatives reveals that whereas Slavin and colleagues have produced significant declines in student depression, anxiety, and stress with increased group cohesion (Slavin et al., 2014; Slavin, 2019), the impacts of curricular changes at the Vanderbilt University School of Medicine have not yet been quantified (Drolet and Rodgers, 2010). In addition to minimizing student distress, the Mental Health 3.0 program also increased student flourishing (Slavin and Chibnall, 2016). The success of Mental Health 3.0 provides strong evidence that diminished medical student well-being is likely a product of multiple factors within the medical learning environment rather than intrinsic student qualities alone (Slavin, 2019).

Mindfulness practices have also become increasingly popular as a wellness intervention. Mindfulness is defined as the non-judgmental awareness of one's own experience with the goal of increasing concentration, insight, and relaxation. Employing mindfulness techniques has been demonstrated to decrease stress and anxiety, though its effects are not as apparent in reducing burnout symptoms (Williams et al., 2015). This lack of effect on burnout symptoms may be due to the focus of mindfulness practices, which is on the individual experience rather than improving the structural entities that cause burnout in the first place (Moir et al., 2018). Mindfulness practices implemented through peer-support groups in a United States medical school failed to demonstrate improvement in student anxiety, depression, quality of life, or resiliency. Though this may have been due to insufficient peer training, a non-blinded study design, or limited participation, these results lend further support to the need for structural corrections to the medical education system rather than improvement in students' attitudes or outlooks (Moir et al., 2018). This is in contrast to the results obtained when primary care doctors underwent a 52-hour mindfulness training course. Post-course surveys revealed reduced burnout and improved empathy sustained for 3 months post-intervention (Dyrbye and Shanafelt, 2016). Comparison of factors contributing to burnout between medical students and practicing clinicians, as well as determining prerequisites for successful implementation of mindfulness programs, may thus be potential areas for research.

Administration and faculty personnel serve as educators and role models for students. Interventions centered on these individuals can thus facilitate a top-down approach to increasing student wellness. A primary concern for German medical students was a lack of coherent information management by faculty with regard to academic expectations, exacerbating the stress of exams and assignments. Solutions offered by students included recording lectures for later viewing and professors providing explicit learning objectives. These students also reported that attendance policies are often too strict and may impede self-care practices, such as utilizing the school counseling system. Proposed solutions were to loosen attendance requirements via a self-reporting absence system (Dederichs et al., 2020). Beyond their academic roles, faculty also often serve as mentors to students. The Liaison Committee on Medical Education requires that schools implement a mentoring system for their students, and these mentors are typically medical school faculty. However, Andre et al proposed a vertical mentoring system that complements faculty involvement with senior students in a program entitled "Mentors in Medicine." This peer-mentoring system was found to be better suited for day-to-day navigation of medical school, while faculty were better suited to offer more long-term career support (Andre et al., 2017). Further integration of mentoring to include financial advisors may reduce distress in students with large amounts of educational debt (Dyrbye et al., 2019). Faculty commitment to wellness initiatives facilitates the development of communal concern for student wellness, extending beyond the Office of Student Affairs (Slavin et al., 2014). Moving forward, faculty and administration will continue to play pivotal roles in student wellness as the medical education system adapts to the technology and challenges of a post-pandemic landscape.

Though a majority of reviewed literature focused on the preclinical years of medical school, important developments have

been made in clinical education as well. Dyrbye and Shanafelt found that a longitudinal rotation curriculum, in which students spend several contiguous months at one training site rather than smaller stints at several training sites, facilitates development of meaningful relationships with preceptors, increasing satisfaction and reducing burnout (Dyrbye and Shanafelt, 2016). This is congruent with Slavin and Chibnall's finding that deploying effective wellness initiatives is made difficult by the changing environment of clinical rotations and lack of control over clinician interactions with students (Slavin and Chibnall, 2016). Further work by Slavin and Chibnall indicates that negative experiences (e.g., mistreatment) during clinical years are a product of resident burnout, which itself results from toxic healthcare structures and environments (Slavin and Chibnall, 2016). For example, residents often experience sleep deprivation, adjustment difficulties, interpersonal conflict, demanding workloads, and a lack of control over their schedule. Interplay between these factors and resident burnout increases likelihood for development of depression and suicidal ideation (Nene and Tadi, 2021). These deleterious resident symptoms may then translate to negative interactions with medical students. Improving the medical student experience can thus be facilitated by ameliorating resident burnout. A potential target for resident burnout interventions is resiliency, which has demonstrated a protective effect against burnout (Sheer et al., 2021; Nituica et al., 2021; Rodrigues et al., 2018). For example, implementation of the Gabbe Health and Wellness program, which was structured around an interprofessional Mindfulness in Motion training, significantly increased resiliency in residents at the Ohio State University Wexner Medical Center (Moffatt-Bruce et al., 2019). The Mindfulness in Motion training consists of a weekly group meeting with five sequential segments: prompted reflective writing, video presentation on mind/body connectivity, voluntary sharing of reflective responses, video instruction on yoga and mindfulness practices, and a closing meditation (Klatt et al., 2020). Though yielding promising results, these methods remain reactive, similar to most medical student wellness initiatives, and do not address the underlying structural causes of burnout within the healthcare system. While current literature lacks specific explorations of the healthcare system's tendency toward reactive change, as opposed to proactive, this may be an extension of the field's prioritization of efficiency and academic success over well-being, as mentioned previously (Gupta, 2018; Symon, 2020). Addressing the correction of such structures is beyond the scope of this review, but deserves serious attention in wellness research. In addition, further explorations of student and resident wellness may involve elucidating the specific motivations within medical culture that keep wellness a low priority within program structuring.

Based on reviewed literature, the following interventions were demonstrated to improve student well-being: transitioning to a P/F grading system, collaborative learning approaches, longitudinal clinical rotation sites, and peer-mentoring programs. General measures for reducing distress include: maintaining hobbies, socialization, positive outlook, avoiding delayed gratification mindsets, learned resiliency, and choosing medicine based off of one's own interests. Mental Health 3.0 offers an evidence-based approach for successfully implementing these interventions. Measures that did not demonstrate significant improvement include: peer-led mindfulness groups and shortening curricular hours (Vidhukumar and Hamza, 2020; Dyrbye and Shanafelt, 2016).

The COVID-19 pandemic caused both immediate and long-term changes to the delivery of medical education. At the onset of the pandemic, medical students were removed from clinical rotations to protect against infection. While this ensured their safety, these students were also deprived of peer-engagement due to asynchronous virtual learning. This shift undoubtedly contributed to increased feelings of isolation and risk for burnout (Klasen et al., 2021). Despite numerous challenges, the pandemic has also provided opportunities for medical educators to innovate with new technology. For example, senior students on emergency medicine rotations have served as a source of virtual follow-up for emergency department (ED) visits after reviewing medical records. This has allowed students to continue clinical skill development while ensuring safety from infection and proper supervision. Virtual ED follow-ups reflect a growing trend for web-side encounters to serve as a temporary substitute or supplement for clinical rotations (Klasen et al., 2021). These digital learning structures were well-received by students, which predicts the persistence of virtual learning in medical school curricula after the COVID-19 pandemic resolves (Dederichs et al., 2020). Despite this apparent positive reception, online learning poses challenges to students' psychological well-being. The asynchronous nature of virtual education modalities lends to feelings of isolation and a lack of motivation during the preclinical years of medical school (Klasen et al., 2021). Combined with the already taxing nature of medical education, the stressors of online learning may ultimately exacerbate existing student wellness concerns. Students featured in "Four Years in Blue: The University of Michigan Medical School Documentary" expressed concern for their future clinical training, specifically with regard to availability of personal protective equipment and physician safety. The students also reported feelings of sadness due to a loss of participation in important class milestones, such as a residency match day celebration (Michigan Medicine, 2020). Future alterations to the global medical education system in light of the pandemic will thus be an active area of research for years to come. Most notably, the pandemic appears to have served as an impetus for the National Board of Medical Examiners and National Board of Osteopathic Medical Examiners to indefinitely suspend the Step 2-Clinical Skills and Level 2-Performance Evaluation requirement for both allopathic and osteopathic students, respectively (AACOM, 2021; USMLE, 2021). Student response to this change and its potential effect on student performance should be thoroughly evaluated in future research.

Conclusions and future work

Further reports of wellness programs and interventions aimed at reducing student stress, developing coping strategies, and preventing burnout are needed. As demand for physicians increases and medical school curricula continue to expand, the potential for worsening student wellness increases. COVID-19, stress of licensure exam preparation, and the increasing cost of medical school all add to the brewing pot of pervasive mental illness, substance use, and burnout in the medical student population. Our review of contemporary literature suggests that transitioning to a P/F grading system and implementing longitudinal, collaborative learning approaches with peer support offer solutions to deteriorating medical student wellness. Electives should also be incorporated within the curriculum to further enhance student engagement and excitement for learning (Slavin, 2014). Academic faculty should be specifically targeted with instruction on how to reduce extraneous information within courses (Slavin et al., 2014; Slavin, 2019). Students should also be encouraged to maintain enjoyable hobbies, cultivate social support networks, and maintain a positive outlook to develop resiliency and protect their mental health (Vidhukumar and Hamza, 2020; Dyrbyre and Shanafelt, 2016). Cognitive behavioral therapy and training in cognitive restructuring techniques should be made available to students in order to address feelings of shame, maladaptive perfectionism, and imposter syndrome (Bynum et al., 2020; Chand et al., 2018; Slavin et al., 2014; Slavin, 2019). Confidential

depression/anxiety tracking systems to screen students for worrisome mental health issues may also aid in identifying at risk students before mental distress becomes fulminant (Slavin, 2019). Faculty and administrators must also strive to improve student wellness from a top-down approach, ensuring that students feel safe to express wellness concerns and seek support when necessary. This may be accomplished through faculty training sessions or development of student liaison committees (Dyrbye et al., 2019; Andre et al., 2017). Programs at the Saint Louis University School of Medicine and Vanderbilt University School of Medicine offer successful templates for implementation of such programming. With the implementation of any intervention, of course, stringent evaluation guidelines must be employed to ensure optimal improvement to student wellness while avoiding unnecessary burdens to students' overwhelming schedule.

Data availability

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

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