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Development of a conceptual model for understanding the learning environment and surgical resident well-being

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ABSTRACT

Background: Surgeon burnout is linked to poor outcomes for physicians and patients. Several conceptual models exist that describe drivers of physician wellness generally. No such model exists for surgical residents specifically.
Methods: A conceptual model for surgical resident well-being was adapted from published models with input gained iteratively from an interdisciplinary team. A survey was developed to measure residents' perceptions of their program. A confirmatory factor analysis (CFA) tested the fit of our proposed model construct.
Results: The conceptual model outlines eight domains that contribute to surgical resident well-being: Efficiency and Resources, Faculty Relationships and Engagement, Meaning in Work, Resident Camaraderie, Program Culture and Values, Work-Life Integration, Workload and Job Demands, and Mistreatment. CFA demonstrated acceptable fit of the proposed 8-domain model.
Conclusion: Eight distinct domains of the learning environment influence surgical resident well-being. This conceptual model forms the basis for the SECOND Trial, a study designed to optimize the surgical training environment and promote well-being.

Introduction

Burnout, defined as a "psychological syndrome of emotional exhaustion, depersonalization, and reduced personal accomplishment," is a pervasive issue among physicians.[1–6] Surgeons in particular have been shown to have high rates of burnout, and a recently published national survey of surgical residents reported that nearly 40% experienced burnout symptoms at least weekly.[7–9] The high prevalence of burnout among physicians and physicians-in-training has garnered much attention as studies have shown its association with increased substance abuse, job turnover,

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thoughts of suicide, and poor patient care and patient outcomes.[10–15]

To better understand the drivers of physician burnout, several conceptual models have been proposed outlining factors that impact physician fulfillment and well-being.[16–22] Conceptual models are critical for succinctly and efficiently representing the key constructs, relationships, and fundamental principles of complex topics.[23] They also help to synthesize and organize existing literature and guide research questions and objectives. In the realm of physician burnout, these conceptual models have been used to highlight the most important areas to consider and address when working to improve physician well-being. However, no such conceptual model has been created specifically for surgical trainees.

While practicing physicians and residents share many of the same experiences and challenges, there may be characteristics specific to the learning environment that are not addressed by current conceptual models but have a profound impact on the wellness of physicians-in-training. Moreover, as surgery residents have high rates of burnout compared to residents in many other specialties, there are likely unique issues that affect the training surgeon that have not been sufficiently described in existing frameworks.[8,9,24] Thus, this study aimed to 1) design a conceptual model that characterizes the aspects of the surgical learning environment that contribute to resident well-being, 2) demonstrate use of such a conceptual to measure surgery residents' perception of their training experience and 3) define the critical targets for improving wellness and preventing burnout.

Materials and methods

An interdisciplinary team was assembled to develop a conceptual model for surgical resident well-being. This team consisted of surgeons, surgery residents, psychiatrists, social and personality psychologists, and health services and outcomes researchers. Careful consideration was placed on creating a diverse group with appropriate representation of different genders, religions, and racial/ethnic backgrounds. The surgical residents represented both university-affiliated and independent community programs from varied geographic locations.

The team began by performing an extensive literature search to identify existing conceptual models on physician well-being, as well as other publications describing factors associated with physician and resident burnout. The research team reviewed and discussed the merits of the identified conceptual models and the relevance of each for understanding the experience of resident physicians. Additionally, as most of these models were created to describe physicians across specialties, the research team also considered how well each model addressed areas that impact surgeon well-being and surgery resident well-being in particular.

A new conceptual model was developed by adapting previously published models to highlight areas influencing surgical resident wellness and burnout.[17–22] The emerging conceptual model was further developed and refined throughout site visits to surgical programs across the country during which the research team conducted interviews and focus groups with surgical residents, surgical faculty, program and institutional leadership, and consultations with physician wellness experts. This model underwent multiple rounds of revision with input and feedback gained iteratively from the research team.

To determine whether it was possible to measure residents' perceptions of their training experience as represented by the domains of our newly constructed conceptual model, a 33-item resident-focused survey instrument was developed with questions related to each area. Several items were taken from previously published surveys and studies such as the Areas of Worklife Survey (AWS), which has been studied in practicing physicians, and were modified to better reflect experiences in surgical residency.[25–28] For example, the AWS asks respondents to report how strongly they agree or disagree with the statement "members of my work group cooperate with one another". We adapted this item to "the residents in my program cooperate with one another" to better align with the resident experience. For novel domains of our conceptual model that did not have corresponding questions in the AWS or other surveys, the research team created new questions to cover relevant content such as duty hour reporting, operative autonomy, and interactions with faculty and support staff (advanced practice providers, social workers, etc.).

The new survey was administered following the 2020 American Board of Surgery In-Training Examination (ABSITE), a multiple-choice exam that is given annually to general surgery residents as a means of measuring clinical knowledge. Resident responses were aggregated at the program level, allowing for evaluation of resident perception of the training experience at each program. A confirmatory factor analysis (CFA) was performed on the program-level data to determine whether the survey questions adequately represented our model. A CFA is a statistical method that evaluates the relationships between observed measures (i.e. survey items/questions) and an *a priori* determined number of latent factors (i.e. conceptual model domains) and can be used to test whether the measured data appropriately represent the hypothesized construct model.[29] We tested two models: 1) a single factor model with all survey items loading on a general factor of the clinical learning environment and 2) a multi-factor model with each of the survey items loading onto the respective domains of our conceptual model. The domains in the multi-factor model were specified as correlated and no cross-factor loadings were included. The CFA examined the factor structure for each construct in the specified model to verify how well they represented the data and analyzed the model's indices for construct validity and unidimensionality. Goodness-of-fit of the model was evaluated using the root mean square error of approximation (RMSEA, with values < 0.08 indicating adequate fit), and the ratio of χ^2 to degrees of freedom (with χ^2:df ratio less than 3:1 indicating adequate fit). All statistical analyses were performed using MPlus version 8. The Northwestern University Institutional Review Board deemed this study exempt.

Results

Following the literature review and iterative discussion amongst the multi-disciplinary, multi-institutional research team, we categorized the factors that influence surgical resident wellness into two main groups: learning environment factors and individual mediating factors. These two groups were derived and adapted from the National Academy of Medicine (NAM) Taskforce Systems Model of Clinician Burnout and Professional Well-Being.[22] Both of these categories influence where residents fall on the well-being – burnout spectrum, which in turn has significant implications for the patients that residents care for, the practicing clinicians that residents work with, and the healthcare system and society as a whole. The primary focus of our model was on the impact of the learning environment on resident well-being. Thus, we further divided the learning environment category into eight separate domains which included: 1) Efficiency and Resources, 2) Faculty Relationships and Engagement, 3) Meaning in Work, 4) Resident Camaraderie, 5) Program Culture and Values, 6) Work-Life Integration, 7) Workload and Job Demands, and 8) Mistreatment. Many of these domains are based on areas from the Shanafelt Model of Physician Burnout and Engagement.[19] Our new conceptual model for understanding the surgical learning environment and surgery resident well-being is shown in Fig. 1. Table 1 summarizes the

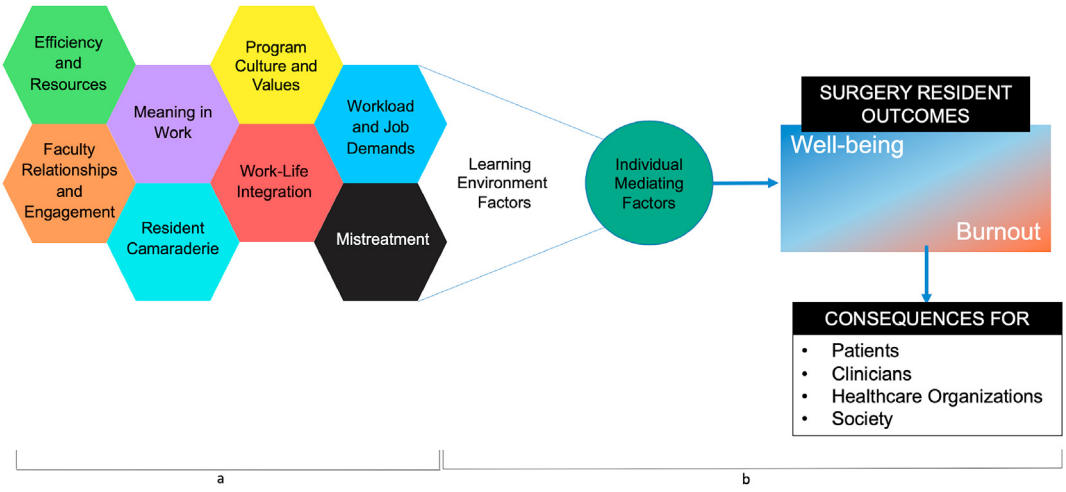

Fig. 1. Conceptual Model for the Surgical Resident Learning Environment and Well-being.
[a] Adapted from the Shanafelt Model of Physician Burnout and Engagement to be specific to surgery residents.[19]
[b] Adapted from the NAM Taskforce Systems Model of Clinician Burnout and Professional Well-Being to be specific to surgery residents.[22]

findings of the literature search.

Efficiency and resources

Surgery residents are faced with the challenge of learning the clinical and operative skills necessary to become independent surgeons while simultaneously completing a myriad of required administrative and clerical tasks for both advancing clinical care and documenting educational compliance and progress. Thus, the efficiency and resources of an institution may have a significant impact on surgeons training there. Availability of experienced support staff, for example, is an issue that can markedly influence the surgery resident experience. Working with skilled advanced practice nurses and physician assistants may allow residents to spend less time on discharge summaries and coding queries and more time in the operating room or at the patient bedside. Similarly, access to program coordinators who are effective and helpful in keeping track of training milestones and requirements may substantially reduce resident administrative burden and improve resident wellness. Additionally, whether surgical programs have the resources and redundancy to meaningful protect resident educational time can have a large impact on surgical resident fulfillment and learning.

Faculty relationships and engagement

Faculty relationships and engagement is a novel area proposed by our conceptual model. The dynamic between residents and attending surgeons can have a significant impact on the training experience. As a field with a long history and tradition of hierarchy, the working relationship between attending surgeons and surgery residents necessarily affects the learning experience. Thus, this domain was included in our conceptual model to emphasize the importance of resident-faculty rapport. Mentorship, for example, is of utmost importance during training and can be extremely influential in professional identity formation and development of clinical expertise. Whether surgical programs promote mentorship or provide mentoring training for faculty members are key issues to consider in this domain. Additionally, this domain encompasses the presence of faculty role models and whether the training program promotes a culture of teamwork and appreciation of and gratitude for resident work.

Meaning in work

Finding meaning in work is a critical issue not only in healthcare but in other careers as well. However, surgery residents face unique challenges in this domain compared to practicing physicians or people in non-medical fields. Surgical training is one of the longest in medicine, with some spending upwards of 10 years as trainees. Maintaining passion for surgical work over such a long period of time may be difficult without being granted the appropriate level of clinical and operative autonomy to progress towards independent practice. Ultimately, this can lead to dissatisfaction with the decision to become a surgeon and can have a detrimental impact on resident well-being.

Resident camaraderie

As the experience during surgical training has been likened to being “in the trenches” together, collegiality among residents plays an important role in wellness. This is a critical but complex topic as creating harmony and functional work relationships among residents is not always easy or intuitive. This domain considers whether the norms and behaviors of the learning environment and surgical program are such that residents not only cooperate with one another but also rely on one another for support in difficult situations. The concept of resident camaraderie is more profound than friendliness and cordial behavior towards one another. Rather, this domain encompasses whether the surgery resident community is a psychologically safe and supportive learning environment in which residents appreciate and help one another to learn and care for patients.

Program culture and values

Organizational Culture and Values is a domain of physician well-being in the Shanafelt Model.[19] For residents, the organizational unit is the training program and the relevant values include handling of adverse events, equity, and ethics. For example, when errors in patient care occur, is the culture of the program to respond with blame or to emphasize learning and growth? Are opportunities distributed and evaluations conducted fairly? Do the values of the program align with the values of the residents such that residents have a sense of belonging? These are all critical questions

Table 1
Summary of key literature, sorted by year of publication.

Model	Factors Identified	Strengths and Limitations in Application to Surgery Residents
Areas of Worklife Model[17] *Describe the factors that contribute to work-related burnout and job stress*	This model identified 6 domains that contribute to work-related burnout and job stress. 1. Workload 2. Control 3. Reward 4. Community 5. Fairness 6. Values	*Strengths* - Highlights the importance of the work environment as a significant contributor to employee wellness and burnout. - Identifies key areas that are also pertinent to the well-being of the training surgeon including workload and control. *Limitations* - Not designed specifically for physicians therefore does not consider specific issues related to healthcare.
Coping Reserve Model[18] *Create a conceptual model for medical student well-being*	In this model, the authors depict a medical students' ability to cope and to be well as a type of reservoir with factors that can contribute to how full the tank is. Factors that contribute positively include: 1. Psychosocial support 2. Social/healthy activities 3. Mentorship 4. Intellectual stimulation Factors that contribute negatively include: 1. Stress 2. Internal conflict 3. Time and energy demands This model also notes that the coping reservoir as a baseline level of fill based on personality and temperament.	*Strengths* - This model was created for medical students and therefore highlights some important concepts related to being a trainee including mentorship. - Discusses relationship between intrinsic and extrinsic factors. *Limitations* - Extrinsic factors listed do not cover entirely the areas that likely influence surgery resident well-being such as control, mistreatment, efficiency and resources, meaning in work and organizational/program culture.
Shanafelt Model of Physician Burnout and Engagement[19] *Determine key domains that drive physician burnout and engagement*	The Shanafelt model identifies 7 domains that influence physician well-being. These include: 1. Workload and job demands 2. Control and flexibility 3. Work-Life integration 4. Social support and community at work 5. Organizational Culture and Values 6. Efficiency and Resources 7. Meaning in Work This model also evaluates the individual, work unit, organizational, and national factors that apply to physicians in each of these domains.	*Strengths* - Adapts the Areas of Worklife domains to be more relevant to physician well-being. - Considers issues that may be more specific to the high demands of a job in healthcare including Work-Life Integration and Meaning in Work. These are also applicable to the training surgeon. *Limitations* - Although applicable to surgery residents, it was not designed with trainees in mind and therefore does not address all issues that may be more salient to residents such as mistreatment.
Stanford WellMD Model[20] *Model the factors influencing physician fulfillment to advance physician and patient well-being*	The Stanford WellMD highlights three domains that regulate physician fulfillment. These domains are: 1. Culture of Wellness 2. Efficiency of Practice 3. Personal Resilience	*Strengths* - Similar to the Coping Reserve Model, this model highlights the interaction between personal qualities and workplace factors. This interaction is important for surgical residents as personal skills are often influenced by the learning environment and vice versa. *Limitations* - Specific domains impacting residents are not overtly specified, such as faculty engagement and resident camaraderie, may decrease ability to apply this model to residents.
NAM Collaborative Model of Factors Affecting Clinician Well-Being and Resilience[21] *Depict factors associated with well-being across all healthcare professions and career stages*	The NAM Model outlines 7 domains of extrinsic and intrinsic factors affecting clinician wellness. Extrinsic factors include: 1. Socio-Cultural Factors 2. Regulatory, Business, and Payer Environment 3. Organizational Factors 4. Learner/Practice Environment Intrinsic factors include: 1. Healthcare Role 2. Personal Factors 3. Skills and Abilities This model also shows how clinician well-being affects the clinician-patient relationship, which ultimately affects patient well-being.	*Strengths* - This model considers the learner/practice environment and highlights many issues that are important considerations such as mentorship and workplace safety. - Showing the relationship between clinician wellness and patient outcomes is another strength of the model, as this connection can be useful in emphasizing the importance of addressing wellness. *Limitations* - As a model that strives to be applicable to all healthcare professionals in any setting, it is complex and detailed in structure. Lack of focus on residents makes it less useful as a framework for addressing surgery resident issues specifically.
NAM Taskforce Systems Model of Clinician Burnout and Professional Well-Being[22] *Show relationship between work system and clinician burnout*	The NAM Taskforce Model identifies three domains of work system factors: 1. External Environment 2. Health Care Organization 3. Frontline Care Delivery The model then depicts a connection between these factors with individual mediating factors, which together lead to clinicians being well or being burned out. This model also shows the implications of clinician well-being on the broader healthcare system.	*Strengths* - This model succinctly describes how both extrinsic and intrinsic factors affect where physicians fall on the wellness—burnout spectrum. - Similar to the NAM Collaborative model, this model connects physician outcomes with consequences for patients, other clinicians, healthcare organizations, and society. *Limitations* - The domains of work system factors are broad and therefore applicable to many physicians. However, they lack the detail necessary to sufficiently describe the surgical learning environment.

to ask when assessing how the culture and values of a training program impact resident well-being. Another important aspect of program culture is respect and inclusion of resident voice. For surgery residents, the issue of control is important, as emphasized in other models.[17,19] However, evaluation of surgical training and discussion with residents revealed that resident control and flexibility are closely aligned with whether the culture of the program is supportive of resident opinions and responsive to resident concerns. The rigor of surgical training demands a significant amount of time from residents. Consequently, affording residents some measure of autonomy and ability to self-govern can have a profound impact on well-being. A program that values resident control, for example, might provide residents with the opportunity to have meaningful input into their rotation and call schedules.

Work-life integration

Work-life integration considers the ability and the support for surgical residents to spend sufficient time on meeting their non-work-related (i.e., personal life) needs. The complex topic of integrating work and life is not unfamiliar to physicians in any specialty. However, there are unique considerations for residents. As the term "resident" implies, physician trainees in the past were expected to spend exorbitantly long hours at the hospital. With changes in duty hour restrictions, residents are no longer allowed to live at the hospital, but there remain unspoken expectations to spend significant time at work. Coupled with the inefficiencies expected of a learner, and the intensity of patient needs, these time commitments can be burdensome and disruptive to life outside the hospital. Additionally, the demographics of residency have begun to change. In a survey of general surgery residents, approximately 50% were married and roughly 22% had children.[30] Accordingly, many surgical residents are faced with obligations that extend beyond the walls of the hospital while the pressures of clinical responsibility remain. Other examples of non-work-related needs include time for routine health maintenance and the ability to pursue healthy habits and social relationships. Forcing residents to view their personal lives and educational/clinical commitments as competing demands may contribute greatly to resident burnout and poor well-being.

Workload and job demands

In the early 2000s, the Accreditation Council for Graduate Medical Education implemented duty hour regulations for resident physicians. While these regulations restrict the number of hours that residents can physically spend in the hospital, the workload and job demands of residency have not necessarily changed. Indeed, as care has become increasingly complex and physicians are pressured to shorten lengths of stay, work compression has increased residents' work demands.[31,32] Thus, the ways in which programs and institutions support residents in fulfilling these obligations is an important issue to consider in resident wellness. This domain therefore considers issues such as duty hour violations, whether surgery residents feel pressured to underreport their hours, and if significant time is spent completing clinical work outside of the hospital.

Mistreatment

Mistreatment, which includes sexual harassment, bullying, verbal or physical abuse, and discrimination on the basis of gender, gender identity, sexual orientation, race, ethnicity, or religion, is an unfortunate but common issue in surgical training.[9,33] Given the historically hierarchical nature of surgery and the inherent power differential within the training structure, surgery residents are uniquely vulnerable to mistreatment. Furthermore, mistreatment may emanate from sources outside the program, such as staff, patients, and patient families. In a recently published study in the New England Journal of Medicine, nearly 50% of surgical residents reported having experienced at least one form of mistreatment, and these experiences were significantly associated with surgery resident burnout, thoughts of attrition, and suicidality.[9] Consequently, a domain that considers issues of resident abuse and mistreatment is a necessary addition in our conceptual model.

Individual mediating factors

Adapted from the NAM Taskforce Model to be specific to surgical residents, individual mediating factors refer to the personal qualities and skills of residents that moderate their response to their learning environment and subsequently their well-being.[22] As surgical residents are often subject to emotionally demanding work and may find themselves in the midst of stressful operative and clinical situations, having refined coping skills and resiliency may contribute greatly to well-being. Previous interventions targeted on improving resiliency have been shown to improve wellness among surgery residents.[34,35] Additionally, given the duration of training, being goal-oriented and having grit can help surgery residents stay motivated. Moreover, as surgery is a highly team-based profession, personal skills in areas like leadership, listening, communication, and conflict resolution may have a significant influence on work dynamics and ultimately well-being and burnout. However, it is important to note that burnout cannot be entirely explained by deficits in the intrinsic qualities of the surgical resident alone and should be considered a consequence of the interaction between learning environment and intrinsic factors.

Survey results

A total of 7233 residents from 324 ACGME-accredited surgery programs responded to our newly developed post-ABSITE survey instrument (85.5% response rate), which contained items related to each of the domains of our conceptual model (Table 2). To test whether our survey accurately captured our model, we performed a confirmatory factor analysis. We tested two models in the CFA: a 1-factor statistical model with all of the program-level responses to survey questions loading on one general factor of the clinical learning environment and an 8-factor statistical model with program-level responses to survey questions loaded onto our eight proposed domains of the learning environment that influence surgical resident well-being. Goodness of fit indices reflected acceptable fit of the 8-factor model (χ^2 (474) = 1248.411; χ^2:degrees of freedom ratio = 2.67; RMSEA = 0.072). Moreover, the 8-factor model was superior to the alternative 1-factor model, which demonstrated poor model fit (χ^2 (459) = 1824.031; χ^2:degrees of freedom ratio = 3.97; RMSEA = 0.091).

Discussion

We describe a novel conceptual model for understanding the impact of the clinical learning environment on surgery resident well-being. We identified eight distinct domains that we believe are critical in evaluating how the learning environment impacts resident wellness and burnout. Many of these domains, including Program Culture and Values, Efficiency and Resources, Meaning in Work, Work-Life Integration, and Workload and Job Demands, were derived from previous models such as the Areas of Worklife Model,[17] the Shanafelt Model for Physician Burnout and Engagement,[19] and the NAM Taskforce model[22] and modified to suit

Table 2
Survey on surgical resident perceptions of the training experience and learning environment.

Domain	Survey Item[a]
Efficiency and Resources	• My program meaningfully protects educational time (e.g., non-resident pager coverage, no expectation to round or run the list during protected conferences). • My program effectively uses support staff (e.g., advanced practice providers, social workers, patient transport, phlebotomists, etc.) to allow me to spend more time on patient care activities. • My residency coordinator is a helpful resource who improves my experience. • My program has adequate computers, workrooms, and materials to allow me to efficiently complete my work. • The nurses respect me and help me do my job.
Work-Life Integration	• Satisfaction with time for personal life (e.g., family, hobbies, dating, social life).[b] • Satisfaction with ability to maintain healthy habits (e.g., exercise regularly, eat healthy food, etc.).[b] • Satisfaction with ability to perform routine health maintenance (e.g., regular visits to dentist and PCP or Ob/Gyn).[b]
Workload/Job Demands	• I feel pressured to underreport my duty hours. • I continue to complete non-educational task work (e.g., charting) while at home. • Number of months in which I violated the 80-hour duty limit this academic year.[c]
Resident Camaraderie	• I feel like I belong in my program. • The residents in my program cooperate with one another. • In difficult situations, I turn to my co-residents for support. • When a resident needs flexibility, other residents willingly step in to help.
Program Culture and Values	• My program emphasizes learning from adverse events or complications rather than placing blame on residents. • The way performance is evaluated within my program is fair. • The way opportunities are distributed within my program is fair. • My program is responsive to resident concerns. • I have meaningful input into my call and vacation schedule. • I feel comfortable speaking up (e.g., about patient care, treatment of a colleague).
Faculty Relationships and Engagement	• I am mentored by a faculty member who genuinely cares about me and my career. • My work is appreciated by my attendings. • Attendings in my program are good role models for residents.
Meaning in Work	• Relative to my training level, I spend an appropriate amount of time in the operating room. • Relative to my training level, I have an appropriate level of operative autonomy. • Relative to my training level, I have an appropriate level of autonomy in patient care and clinical decision-making. • Satisfaction with decision to become a surgeon.[b]
Mistreatment	• Frequency of experiencing discrimination based on gender.[d] • Frequency of experiencing discrimination based on race/ethnicity.[d] • Frequency of experiencing discrimination based on past, present, or expected pregnancy status or child-care needs.[d] • Frequency of experiencing verbal/emotional abuse or bullying.[d] • Frequency of experiencing sexual harassment.[d]

[a] Unless otherwise noted, answer options included Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree.
[b] Answer options included Very Dissatisfied, Dissatisfied, Neutral, Satisfied, and Very Satisfied.
[c] Answer options included 0,1,2,3,4,5 or 6 months.
[d] Answer options included Never, A few times a year, One time a month or less, A few times a month, One time a week, A few times a week, and Every day.

surgical residency.

Unique to our conceptual model are the three domains of Faculty Relationships and Engagement, Resident Camaraderie, and Mistreatment. While the idea of community at work has been discussed in previous models,[17,19] the hierarchical nature of surgical residency profoundly complicates workplace relationships. As faculty are in a position of power, their engagement in the resident learning experience is an important consideration for residents and may differ from the supervisor-employee dynamic identified for practicing physicians and other professions. Hierarchy exists within the resident cohort as well, highlighting the impact that resident camaraderie and cohesion can have on wellness. Finally, mistreatment of all varieties is an issue that has not been expressly discussed in other conceptual models for physician well-being but is correspondingly related to the inherent power differential for physicians-in training, which makes them uniquely vulnerable to these negative behaviors when they manifest from more senior residents, nursing staff, faculty, administration, patients, and patient families.

Although our conceptual model is primarily focused on learning environment factors and the impact of the learning environment on resident well-being, we maintain the importance of individual mediating factors on the surgery resident experience, as emphasized in other models.[18,20,22] Similar to these other models, our conceptual model denotes that individual mediating factors play a role in resident well-being and burnout, but we strongly contend that these factors must be viewed in the context of the learning environment. Singular focus on individual skill-building without attempts to improve or eliminate workplace drivers of burnout may be interpreted as victim-blaming and thus worsen well-being. In addition to emphasizing the interplay between environmental factors and individual qualities, our conceptual model also makes note of the impact of resident well-being on patients, clinicians, healthcare organizations, and society. Our model parallels the NAM Taskforce Model in stressing that the mental wellness of surgery residents also has the potential to influence patient and hospital outcomes. Providing this context may bolster attention to this important topic.[21,22]

By identifying the aspects of the learning environment critical for well-being in our conceptual model, we recognized the opportunity to improve the surgical training experience through evaluation of residents' perceptions of their surgical programs in each of these domains. While in-depth summary and interpretation of resident responses to the post-ABSITE survey are outside of the scope of this manuscript, the results of our confirmatory factor analysis suggested that the survey tool we developed adequately represented our conceptual model and could therefore be utilized to measure program performance in these areas. This could then be used to benchmark programs and foster monitoring of residents' evaluation of their program, with a goal of continuous improvement in these parameters, and ultimately resident well-being.

This study has limitations. First, as our aim was to create a conceptual model specific to the surgical learning environment and the surgery resident experience, this model is not necessarily

generalizable to residents in other specialties. Although we believe it likely has broad applicability, there may be issues that impact residents in non-surgical fields that are not adequately addressed by the model. Second, while our model outlines eight different domains of learning environment factors that impact resident wellness and burnout, our model does not fully account for the importance of each domain relative to one another or the overlap or interactions between domains.

Conclusion

Our conceptual model has the potential to help improve surgery resident well-being by providing a robust theoretical foundation for the **S**urgical **E**ducation **C**ulture **O**ptimization through targeted interventions based on **N**ational comparative **D**ata Trial, also known as the SECOND Trial.[35] A national, prospective, cluster-randomized study, the SECOND Trial aims to optimize surgical training to promote well-being and prevent burnout among residents. Surgical programs randomized to the intervention arm of the SECOND Trial received an in-depth, de-identified report of their program's performance in each of the eight learning environment domains of our conceptual model, as measured by our survey tool and benchmarked against other programs in the country. Intervention arm programs also gained access to a multidimensional, web-based "Wellness Toolkit" of program-level interventions targeted to each domain. We hypothesize that the combination of this toolkit with program-specific data will allow surgical training programs to recognize and improve deficits in the learning environment and thus improve their residents' well-being. Finally, although this conceptual model was designed specifically to describe the surgical resident experience, both surgical and non-surgical training programs may find this framework to be an applicable and meaningful tool for improving well-being and preventing burnout in residency.

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Role of the funder/sponsor

The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer

The results and conclusions of this article are the authors' own and do not represent the opinions of the Accreditation Council for Graduate Medical Education, the American College of Surgeons, or the American Board of Surgery.

Declaration of competing interest

Dr Shanafelt is co-inventor of the Well-being Index Instruments (Physician Well-being Index, Medical Student Well-being Index, Nurse Well-being Index, the Well-being Index) and the Participatory Management Leadership Index. Mayo Clinic holds the copyright for these instruments and has licensed them for use outside Mayo Clinic. Dr Shanafelt receives a portion of any royalties paid to Mayo Clinic. As an expert on healthcare professional well-being, Dr. Shanafelt frequently presents grand rounds or keynote lectures and advises healthcare organizations. He receives honoraria for some of these engagements.

Dr. Riall is a certified professional coach and founder of Taylor Your Success Coaching. Dr. Nasca reports personal fees from Accreditation Council for Graduate Medical Education outside the submitted work. The authors report no other conflicts of interest, financial or otherwise, related to this work.

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