

Original Research

Burnout in Graduate Medical Education: Uncovering Resident Burnout Profiles Using Cluster Analysis

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Abstract

Background

Burnout is common among residents and negatively impacts patient care and professional development. Residents vary in terms of their experience of burnout. Our objective was to employ cluster analysis, a statistical method of separating participants into discrete groups based on response patterns, to uncover resident burnout profiles using the exhaustion and engagement sub-scales of the Oldenburg Burnout Inventory (OLBI) in a cross-sectional, multispecialty survey of United States medical residents.

Methods

The 2017 ACGME resident survey provided residents with an optional, anonymous addendum containing 3 engagement and 3 exhaustion items from the OBLI, a 2-item depression screen (PHQ-2), general queries about health and satisfaction, and whether respondents would still choose medicine as a career. Gaussian finite mixture models were fit to exhaustion and disengagement scores, with the resultant clusters compared across PHQ-2 depression screen results. Other variables were used to demonstrate evidence for the validity and utility of this approach.

Results

From 14 088 responses, 4 clusters were identified as statistically and theoretically distinct: Highly Engaged (25.8% of respondents), Engaged (55.2%), Disengaged (9.4%), and Highly Exhausted (9.5%). Only 2% of Highly Engaged respondents screened positive for depression, compared with 8% of Engaged respondents, 29% of Disengaged respondents, and 53% of Highly Exhausted respondents. Similar patterns emerged for the general query about health, satisfaction, and whether respondents would choose medicine as a career again.

Conclusion

Clustering based on exhaustion and disengagement scores differentiated residents into 4 meaningful groups. Interventions that mitigate resident burnout should account for differences among clusters.

Keywords

burnout; cluster analysis; depression; graduate medical education; job satisfaction; Oldenburg Burnout Inventory (OLBI); PHQ-2; resident physicians; validity study

Introduction

There is considerable interest in the causes and effects of burnout along with the various methods to reduce its prevalence and impact in medical education and practice.^{1,2} The World

Health Organization has recognized burnout as both a health and occupational problem.^{3,4} Burnout emerges in medical school, continues through graduate medical education, and remains prevalent among practicing physicians.⁵⁻⁷

Reported resident burnout rates vary widely, with 1 qualitative study reporting that 82% of medical residents were at least moderately affected by burnout.⁸ At any given time, approximately 1 of every 3 practicing physicians is experiencing burnout.^{4,9}

Negative health effects associated with burnout include insomnia, heart disease, obesity, depression, anxiety, and increased vulnerability to illness.¹⁰⁻¹² Organizational disruptions include turnover, absenteeism, and reduced job performance.¹³ In 1 internal medicine study, residents experiencing burnout were more than twice as likely to report providing suboptimal care.¹⁴ Other studies found that burnout can result in higher error rates¹⁵ and increases in patient mortality.^{16,17} Another study found that self-perceived medical errors were associated with higher rates of personal distress.¹⁸ In palliative care health professionals, participants with burnout syndrome (experiencing exhaustion, depersonalization, and cynicism) scored lower on cognitive tests than their peers.¹⁹ Further, higher levels of burnout can negatively impact working memory and decision making, interfering with the learning process.¹⁹

The most widely used instrument for burnout assessment is the Maslach Burnout Inventory (MBI),²⁰⁻²⁶ which contains 3 subscales, emotional exhaustion, depersonalization, and personal accomplishment. Recent work using the MBI has dichotomized burnout (burned out, not burned out) using either emotional exhaustion or depersonalization as threshold criteria.²⁷ The Oldenburg Burnout Inventory (OLBI), an alternative measure of burnout, assesses 2 core dimensions of burnout from work-exhaustion and engagement, excluding the personal accomplishment represented in the MBI.^{23,28,29} The OLBI was chosen for this analysis as it demonstrates comparable validity evidence and similar psychometric properties to the MBI and because it is freely available for use.²⁸⁻³⁰ Further, it has been used by the Association of American Medical Colleges (AAMC) for their annual surveys of medical students since 2014.

Regardless of how it is measured or defined, burnout is a complex phenomenon.^{1,23,26} Much of the published burnout work in medical education emphasizes its presence or absence,^{31,32} limiting the potential for varied prevention

and mitigation strategies. The objective of our study was to determine whether cluster analysis, a process of grouping respondents who have similar response patterns to specific survey items, would reveal potentially distinct burnout profiles for residents and fellows, allowing for varied and specific interventions. To contribute validity evidence for these differentiated profiles, resultant clusters were compared in terms of rates of screening positive for depression on the Patient Health Questionnaire-2 (PHQ-2),³³ a general query about health and satisfaction, and whether respondents would still choose medicine as a career.

Methods

Between January and April of 2017, researchers at the Accreditation Council for Graduate Medical Education (ACGME) offered resident physicians and fellows enrolled in accredited programs an optional, anonymous addendum following the completion of the required annual ACGME Resident Survey to query trainee well-being nationwide. This voluntary addendum, hosted by SurveyMonkey (San Mateo, CA), was accessed via a link that was separate from ACGME servers. Language explaining that the survey could not be connected to the accreditation-based survey data, nor the training program or sponsoring institution preceded the SurveyMonkey link. This project was deemed exempt from Institutional Review Board approval by the American Institutes of Research (EX000252) following an expedited review.

The optional set of questions included queries about burnout, exhaustion, mental health, and demographic characteristics (**Appendix A**). It included 3 exhaustion items and 3 engagement items from the OLBI,³⁴ (**Table 1**) the 2-item PHQ-2,³³ one item querying general health, and 1 item querying whether or not respondents would still choose a career in medicine. The PHQ-2 queries both dysphoria and anhedonia, exhibits strong correlation with diagnosis,³³ and was designed and used as an initial screen for depressive disorders.³⁵ Participants were also asked to rate their level of satisfaction with their residency experience on a scale of 1 to 7 and to report the frequency of feeling tired or having little energy, of experiencing excess time pressure, and not having sufficient time to

Table 1. Selected Oldenburg Burnout Inventory Items²³

Engagement items (Strongly agree = 1, Agree = 2, Disagree = 3, Strongly disagree = 4)
1. I always find new and interesting aspects in my work.
2. I find my work to be a positive challenge.
3. I feel more and more engaged in my work.
Emotional exhaustion items (Strongly agree = 4, Agree = 3, Disagree = 2, Strongly disagree = 1)
4. After work, I tend to need more time than in the past in order to relax and feel better.
5. During my work, I often feel emotionally drained.
6. After my work, I usually feel worn out and weary.

think or reflect over a 2-week response window. Respondents reported their gender identity, specialty or subspecialty, and training level.

The complete OLBI is a 16-item scale that measures burnout as a function of 2 subscales, engagement and exhaustion, each with 8 items. To ease the survey burden, only 3 items from each subscale were included (**Table 1**). This decision was based on previous work by Grbic, demonstrating that a 2-measurement (engagement and exhaustion) factor model utilizing these 6 items represented a good fit in both a confirmatory and explanatory factor analysis of 8497 second-year medical students on the 2014 American Association of Medical Colleges Medical School Year Two Questionnaire (Y2Q).³⁶ In this analysis, Grbic found that utilizing response data from these 6 items mirrored the variance and response patterns of utilizing all 16 OLBI items.

Statistical Analyses

Responses to the 3 exhaustion items were summed, with a Cronbach's alpha of 0.81, to create an aggregated exhaustion score. Similarly, an aggregated disengagement score was calculated, with a Cronbach's alpha of 0.84. Gaussian finite mixture models, which utilize an expectation-maximization algorithm to calculate model parameters (**Appendix B**), were fit to the exhaustion and disengagement scores using the *mclust* package³⁷ within the R statistical software Version 3.5.3 (Vienna, Austria).³⁸ The choice of utilizing finite Gaussian mixture modeling for the cluster analyses was based on the ability of the modeling to capture complex patterns that account for the potential heterogeneity in cluster shape and density.

To determine an appropriate number of latent classes, solutions were fit and compared using

the Bayesian information criteria, interpretability and meaningfulness of the clustering solution, and the principle of parsimony. After selecting a clustering solution, chi-square and Welch's variance weighted-ANOVA analyses were conducted on the association between clusters and differences in gender, general health, whether respondents would choose a medical career, the PHQ-2 depression screen, ratings of residency experience, and feelings of fatigue or excess time pressure over a 2-week response window.

We collected validity evidence as follows. The initial content validity and response process of the six items was based on prior work using OLBI.^{23,28,29} Internal structure validity of the 2 newly created scores included internal consistency (Cronbach's alphas of 0.81 and 0.84) and the results of the cluster analysis. Finally, we explored relationships to other variables by exploring differences among the clusters in terms of measures of well-being and satisfaction as evidence for the validity of this cluster analysis approach of disengagement and exhaustion scores.³⁹ Cluster comparisons were performed with SAS Enterprise Guide Version 7.1 (Cary, NC).

Results

The study population consisted of 14 088 residents and fellows who responded to all 6 burnout items, representing 11% of all residents and fellows (129 720) training in ACGME-accredited programs in the 2016-2017 academic year.⁴⁰ Respondents included residents and fellows in all specialties, subspecialties, and all training levels (**Appendix C**). Based on self-reported demographic information, the study population reflected the broader resident and fellow population (see **Appendix C** for comparisons).

Results of Mixture Modeling

Using goodness of fit, interpretability, and notable differences across other measured variables, we chose the 4-cluster solution. The 4 clusters were ellipsoidal and of varying volume, shape, and orientation.³⁷ **Figure 1** visually presents the range of both engagement and exhaustion scores for each of the 4 clusters. Based on the exhaustion and disengagement score distributions, we labeled the clusters using their respective characteristics: Highly Engaged (3636, 25.8%), Engaged (7780, 55.2%), Disengaged (1330, 9.4%), and Highly Exhausted (1342, 9.5%). Mean exhaustion scores, disengagement scores, mean responses to each of the 6 OLBI items, and all corresponding standard deviations are shown for each cluster in **Table 2**. Male respondents were 53% of the Highly Engaged cluster, while female respondents represented 60% of the Highly Exhausted cluster (**Table 3**).

Cluster Differentiation With Depression and Other Measures

The 4 cluster profiles differed in terms of general health, depression, residency ratings, feeling tired, excess time pressure, lack of time to think or reflect, and whether they would choose medicine again (all $P < .001$, **Table 3**).

A score of 3 or greater on the PHQ-2 was considered a positive screen for depression, while a score of 2 was considered a positive screen for signs and symptoms of depression.³³ Only 2% of those classified as Highly Engaged screened positive for depression; 8% of Engaged respondents screened positive; 29% of Disengaged respondents screened positive; and over half of Highly Exhausted respondents screened positive for depression. Just over 7% of Highly Engaged respondents reported signs and symptoms of depression, compared with 21% of Engaged respondents, 32% of Disengaged respondents, and 29% of Highly Exhausted respondents.

Ratings of the residency experience paralleled depression, with the Highly Engaged group reporting the highest ratings followed by the Engaged, Disengaged, and Highly Exhausted groups. Similar response patterns are shown in **Table 3** for days feeling tired or having little energy, days with too much to do and too little time, and days without enough time to think and reflect. Over the 2-week response window, Highly Engaged residents reported these negative experiences once or twice per week while those clustered as Highly Exhausted reported them nearly every day. In terms of general health, 86% of Highly Engaged residents

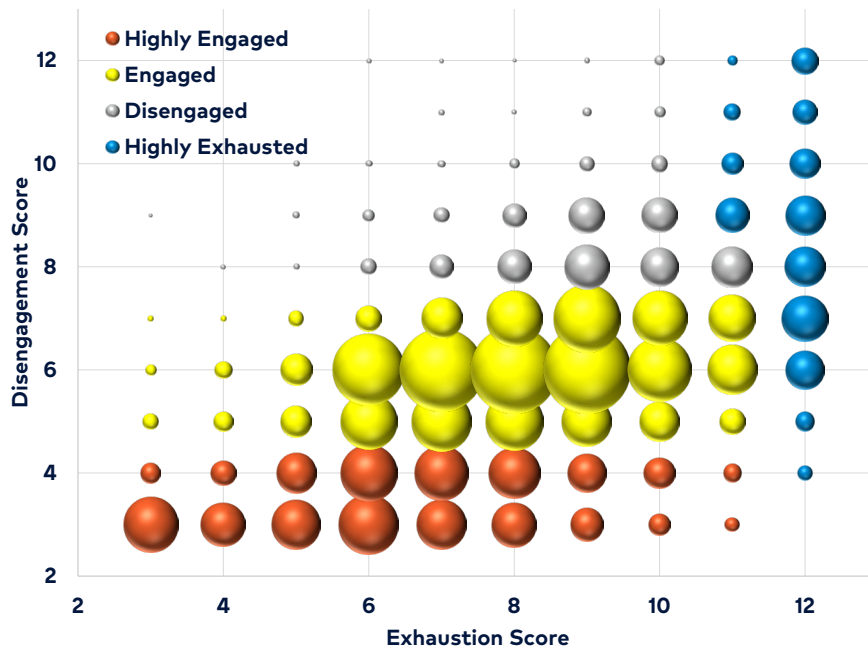


Figure 1. Cluster distribution is demonstrated across Emotional Exhaustion and Disengagement Scores. There were 4 clusters identified. The area of the bubble represents the proportion of the sample at each score.

Table 2. Mean Scores and Mean Burnout²³ Item Responses by Cluster. Standard Deviations in Parentheses

Score or item	Cluster name			
	Highly Engaged	Engaged	Disengaged	Highly Exhausted
Emotional Exhaustion Score*	6.36 (1.99)	8.10 (1.66)	9.11 (1.34)	11.83 (0.38)
After work, I tend to need more time than in the past in order to relax and feel better.†	2.19 (0.92)	2.76 (0.78)	2.98 (0.72)	3.91 (0.28)
During my work, I often feel emotionally drained.†	1.96 (0.73)	2.53 (0.69)	2.96 (0.65)	3.95 (0.23)
After my work, I usually feel worn out and weary.†	2.21 (0.80)	2.81 (0.69)	3.17 (0.62)	3.97 (0.16)
Disengagement Score‡	3.45 (0.50)	5.99 (0.69)	8.52 (0.79)	8.35 (1.90)
I always find new and interesting aspects in my work.§	1.09 (0.28)	1.93 (0.40)	2.85 (0.49)	2.67 (0.79)
I find my work to be a positive challenge.§	1.04 (0.19)	1.87 (0.39)	2.65 (0.58)	2.67 (0.76)
I feel more and more engaged in my work.§	1.33 (0.47)	2.19 (0.46)	3.02 (0.41)	3.00 (0.71)

*Emotional exhaustion scores range from 3 as the lowest possible score, meaning the least amount of emotional exhaustion, to 12 as the highest possible score.

†For emotional exhaustion items, scoring was as follows: Strongly agree = 4, Agree = 3, Disagree = 2, Strongly disagree = 1.

‡Disengagement scores range from 3 as the lowest possible score, meaning the highest level of engagement, to 12 as the highest possible score.

§Engagement items were reverse coded for consistency: Strongly agree = 1, Agree = 2, Disagree = 3, Strongly disagree = 4.

reported excellent or very good health compared with only 33% of their Highly Exhausted peers. As to whether they would choose medicine as a career if they could do it all over again, responses also varied by cluster, with 92% of Highly Engaged residents responding positively compared to only 27% of Highly Exhausted residents.

Discussion

Our analysis of 14 088 residents' and fellows' responses resulted in 4 burnout profiles: Highly Engaged (25.8%), Engaged (55.2%), Disengaged (9.4%), and Highly Exhausted (9.5%). Highly Engaged residents reported finding work to be both interesting and a positive challenge, whereas Engaged residents reported similar attitudes about work, though less consistently. Those classified as Disengaged reported more difficulty finding work to be either interesting or a positive challenge; those classified as Highly Exhausted felt emotionally drained during work and "worn out" following work. The findings suggest meaningful differ-

ences between engagement and exhaustion and their role in the manifestation of burnout among medical residents and fellows.

Highly Engaged residents and fellows expressed the highest level of satisfaction with both their training and with medicine as a career, reported the best general health, experienced the fewest days with excess time pressure, and were least likely to screen positive for depression. Of concern were the Highly Exhausted residents and fellows, who expressed the lowest satisfaction with training and medicine, reported the worst general health, experienced excess time pressure nearly every day, and were most likely to screen positive for depression.

A cluster analysis approach has been utilized previously to create differentiated profiles for medical residents related to how they spend their time when not working or sleeping.⁴¹ Similar approaches have been employed successfully in non-physician populations to address

Table 3. Within Cluster Proportions and Means of Selected Variables

	Cluster name			
	Highly Engaged	Engaged	Disengaged	Highly Exhausted
Gender identity*[†]				
Female (n, proportion of cluster)	1624 (46.71%)	3792 (51.60%)	591 (48.52%)	732 (59.27%)
Male	1853 (53.29%)	3557 (48.40%)	627 (51.48%)	503 (40.73%)
Choose medicine again[†]				
Yes (n, proportion of cluster)	3293 (92.63%)	5500 (72.60%)	429 (33.00%)	356 (26.85%)
Not sure	187 (5.26%)	1322 (17.45%)	373 (28.69%)	333 (25.11%)
No	75 (2.11%)	754 (9.95%)	498 (38.31%)	637 (48.04%)
General health*[†]				
Excellent (n, proportion of cluster)	1745 (48.02%)	1764 (22.69%)	198 (14.89%)	113 (8.43%)
Very good	1373 (37.78%)	3330 (42.82%)	404 (30.38%)	326 (24.31%)
Good	431 (11.86%)	2119 (27.25%)	474 (35.64%)	421 (31.29%)
Fair	80 (2.20%)	509 (6.55%)	211 (15.86%)	360 (26.85%)
Poor	5 (0.14%)	54 (0.69%)	43 (3.23%)	121 (9.02%)
Depression screen (PHQ2)³¹				
Positive screen [†] (PHQ2 ≥ 3) (n, proportion of cluster)	75 (2.07%)	639 (8.25%)	387 (29.32%)	705 (52.73%)
Signs and symptoms [†] (PHQ2 = 2) (n, proportion of cluster)	267 (7.34%)	1644 (21.13%)	419 (31.50%)	384 (28.61%)
Selected means (standard deviations)*[†]				
Rating of residency experience (1 = poor, 7 = excellent)	6.27 (0.95)	5.29 (1.16)	3.80 (1.37)	3.40 (1.55)
Days feeling tired or having little energy over past 2 weeks	3.48 (3.32)	5.84 (3.72)	8.18 (3.84)	11.09 (3.06)
Days with excess time pressure at work over past 2 weeks	3.10 (3.65)	5.18 (4.12)	7.33 (4.44)	10.32 (4.01)
Days without enough time to think and reflect over past 2 weeks	2.67 (3.63)	5.35 (4.39)	8.05 (4.62)	11.11 (3.59)

Note: number of respondents followed by proportion of clustered respondents in each variable response category

*Gender Identity was queried with four response options: Female, Male, Decline to respond, and Other. Only respondents who identified as female or male are included for statistical purposes.

[†]Chi-square *P* value < .0001

*Welch's variance-weighted ANOVA *P* value < .001. All pairwise comparisons were significant at the .001 level by Tukey's studentized range test.

the complexity of burnout⁴² and its relationship with other well-being constructs.^{43,44} Our results provide evidence of validity for the use of cluster analysis to create differentiated burnout profiles in residents and fellows. Notably, the discrete profiles were differentially tied to outcomes of interest, such as well-being and satisfaction with residency. Further, our results support the use of cluster analysis to account for the variance of burnout and its subconstructs, differentiating it from the simple threshold model that categorizes individuals as burned out or not.⁷ Using a methodology such as cluster analysis may provide a richer lens by which researchers and practitioners can better understand how physicians experience burnout and how its effects may change or evolve.

Training programs and institutions are responsible for implementing systematic initiatives aimed at alleviating burnout, such as restructuring schedules and reducing workload intensity.^{2,45} Although some interventions have demonstrated improvement in resident physician burnout, these effects are often small.^{46,47} This may be, in part, a function of how burnout is traditionally assessed, focusing only on those who are “burned out,” conceptualizing burnout only as emotional exhaustion,^{46,48,49} or providing a single intervention (eg, reducing duty hours,^{47,50} mindfulness-based stress reduction).^{50,51} These interventions may not fully account for the fact that burnout manifests differently across individuals and contexts.

The emergence of the 4 clusters of residents and fellows found in our study, differentiated based on their reported disengagement and exhaustion, suggests the need for more differentiated mitigating strategies. In accounting for the presence of different burnout profiles among residents, more specific interventions can be identified and used to mitigate burnout’s negative impact on resident physicians’ well-being.

In terms of interventions, all residents and fellows benefit from positive and supportive work environments.^{4,17,35,46,52} Those struggling with disengagement could benefit from direct coaching, helping them derive meaning in providing patient care and tapping into their intrinsic professionalism and empathy. Seriously exhausted residents may benefit from breaks

in the intensity of their work, giving them time to rest, sleep, and reflect. They may also require targeted interventions such as academic mentorship or psychological support. The most highly engaged residents may need to become sensitized to the signs and symptoms in themselves and their colleagues and reach out with an understanding voice or a helping hand.⁵³ Given the gender differences in cluster membership, interventions may need to account for residents’ and fellows’ gender identities. Additionally, programs and institutions must provide safe avenues for individuals to access needed support. Future work should examine whether interventions are more effective when they are specific to residents based on their levels of exhaustion and disengagement.

Burnout and Depression

In this analysis, burnout and depression were treated as distinct constructs.^{54,55} We employed the PHQ-2 to illustrate the differing rates of positive depression screens across burnout clusters. Though exhaustion is a common feature both in the OLBI as well as in many depressive disorders, the PHQ-2 does not query exhaustion or fatigue. The recognized conceptual overlap between burnout and depression^{56,57} provided validity evidence of relationships with other variables for the cluster analysis approach, as rates of depression varied across clusters. These results support the use of cluster analysis and may partially explain the differential proportions of the sample that fell into the Disengaged and Highly Exhausted clusters.

Limitations

These data were collected in early 2017, 3 years before COVID-19 reached the US. Also, the results of this analysis are subject to sampling bias as our sample represented 11% of the total population of residents and fellows in the US in 2017. The use of a reduced number of OLBI items may further limit the generalizability of our results. The data included in these analyses were from self-report survey data, subject to social desirability bias given the sensitive topics of burnout and depression. Despite attestations that this set of questions was separate from the main accreditation surveys, some participants may have had concerns regarding the identification of their responses as well as

potential repercussions for their training programs should they respond in certain ways.⁵⁸ Finally, all data collected were cross-sectional, eliminating the potential to assess causality and the ability to account for extant environmental situations (eg, challenging rotations, night shifts, and interpersonal conflict). We believe these limitations have a minimal impact on our conclusions, as the purpose was to demonstrate the utility and validity of using cluster analysis to reveal resident and fellow burnout profiles.

Conclusion

Clustering, based on exhaustion and disengagement scores, separated residents into 4 discrete profiles, differing significantly in terms of satisfaction with training and medicine as a career, general health, feelings of excess time pressure, and depression. This novel framing will require further exploration. We believe that the existence of these profiles has important implications for understanding and addressing the general well-being of physicians in training. Future research involving mixture model approaches and systematic sampling may provide additional validation for this 4-cluster solution. Similar approaches that account for the differential impact of the subscales of burnout may be useful in identifying ameliorative interventions. Future studies may extend into specialty-specific analysis.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Appendix A. Selected Survey Items and Introductory Language

Click here to tell us more about what residency is like!

This optional survey should take five minutes. Neither your name nor your residency program's details are being collected for this questionnaire. Your responses to the questions that follow will be kept COMPLETELY separate from the ACGME accreditation database and will NOT be used for accreditation purposes. This questionnaire will NOT be connected in any way to the ACGME Surveys database and as such, is not being administered using ACGME systems. You are under no obligation to participate. There is no link to the ACGME, so there will be no way of knowing who has or has not participated.

Please complete the questionnaire in one sitting as there is no way to save your responses or return to where you have left off. If you have any questions or concerns, please feel free to contact Dr. DeWitt C. Baldwin, Jr. at xxx-xxx-xxxx or Nicholas Yaghmour at xxx-xxx-xxxx. Your participation is greatly appreciated!

1. In general, my health is ____?
 - a. Excellent
 - b. Very Good
 - c. Good
 - d. Fair
 - e. Poor
2. How would you rate your overall residency experience?
 - a. 1 Poor
 - b. 2
 - c. 3
 - d. 4
 - e. 5
 - f. 6
 - g. 7 Excellent
3. PHQ-2: Over the past 2 weeks, how often have you been bothered by any of the following problems?
 - a. (Anhedonia) Little interest or pleasure in doing things
 - i. Not at all (0)
 - ii. Several Days (1)
 - iii. More than Half the Days (2)
 - iv. Nearly Every Day (3)
 - b. (Depressed mood) Feeling down, depressed, or hopeless
 - i. Not at all (0)
 - ii. Several Days (1)
 - iii. More than Half the Days (2)
 - iv. Nearly Every Day (3)
4. Oldenburg Burnout Inventory: Below you find a series of statements with which you may agree or disagree. Using the scale, please indicate the degree of your agreement by selecting the response that corresponds with each statement.
 - a. (Engagement) I always find new and interesting aspects in my work.
 - i. Strongly agree (1)
 - ii. Agree (2)
 - iii. Disagree (3)
 - iv. Strongly Disagree (4)

- b. (Exhaustion) After work, I tend to need more time than in the past in order to relax and feel better.
 - i. Strongly agree (4)
 - ii. Agree (3)
 - iii. Disagree (2)
 - iv. Strongly Disagree (1)
 - c. (Engagement) I find my work to be a positive challenge.
 - i. Strongly agree (1)
 - ii. Agree (2)
 - iii. Disagree (3)
 - iv. Strongly Disagree (4)
 - d. (Exhaustion) During my work, I often feel emotionally drained.
 - i. Strongly agree (4)
 - ii. Agree (3)
 - iii. Disagree (2)
 - iv. Strongly Disagree (1)
 - e. (Exhaustion) After my work, I usually feel worn out and weary.
 - i. Strongly agree (4)
 - ii. Agree (3)
 - iii. Disagree (2)
 - iv. Strongly Disagree (1)
 - f. (Engagement) I feel more and more engaged in my work.
 - i. Strongly agree (1)
 - ii. Agree (2)
 - iii. Disagree (3)
 - iv. Strongly Disagree (4)
5. Over the last 2 weeks, how many days have felt tired or had little energy? (Responses 0 – 14 days)
 6. Over the last 2 weeks, how many days have you felt like you had too much to do and too little time at work? (Responses 0 – 14 days)
 7. Over the last 2 weeks, on how many days have you felt that you did NOT have enough time to think and reflect? (Responses 0 – 14 days)
 8. Knowing what you know today, if you could do it all over again, would you select medicine as a career?
 - a. Definitely Not
 - b. Probably Not
 - c. Not Sure
 - d. Probably Yes
 - e. Definitely Yes
 9. What is the specialty of your current residency or fellowship program? Please choose from the pull-down menu.
 10. Please select the option below that best describes your training level. (Response options vary by specialty)
 11. Please mark the option below that best matches your gender identity.
 - a. Female
 - b. Male
 - c. Other
 - d. Decline to Answer

Appendix B. Description of Gaussian Finite Mixture Modeling Approach to Cluster Analysis

- Assumes that the observed multivariate distribution of the variables is made up of unobserved or latent subpopulations, each of which follows a multivariate normal distribution
- Accounts for subpopulations (or latent classes) of different sizes, differing covariance structures (variance and covariance of exhaustion and disengagement) within each subpopulation, flexibility in approximating observed distributions, and probabilistic classification (a probability of subpopulation membership is provided for each observation)
- Allows for the inclusion of the covariance between variables (exhaustion and disengagement scores)
- Allows subpopulations to have elliptical shapes as opposed to the spherical clusters formed by other clustering methods, such as k-means clustering

Appendix C. Respondent Demographics, Population Demographics, and Response Rates

Variable	Self-reported respondent characteristics (n = 14 088)		Population characteristics ⁴¹ (N = 129 720)		Response rate
Mean age	31.1		30.7		NA
Gender	Sample n	Sample proportion	Population N	Population proportion	Response rate
Female	6739	47.8%	57 130	44.0%	11.8%
Male	6540	46.4%	68 613	52.9%	9.5%
Other/Decline/Skipped/Not reported	809	5.7%	3977	3.1%	NA
Year in training	Sample n	Sample proportion	Population N	Population proportion	Response rate
PGY1	3416	24.2%	33 453	25.8%	10.2%
PGY2	3326	23.6%	30 070	23.2%	11.1%
PGY3	3195	22.7%	28 532	22.0%	11.2%
PGY4+ (includes fellowships)	3508	24.9%	37 665	29.0%	9.3%
Missing	643	4.6%	NA	NA	NA
Specialty	Sample n	Sample proportion	Population N	Population proportion	Response rate
Anesthesiology	711	5.0%	6207	4.8%	11.5%
Dermatology	132	0.9%	1424	1.1%	9.3%
Emergency Medicine	611	4.3%	6885	5.3%	8.9%
Family Medicine	1328	9.4%	11 277	8.7%	11.8%
General Surgery	1013	7.2%	8184	6.3%	12.4%
Internal Medicine	2653	18.8%	26 301	20.3%	10.1%
Internal Medicine subspecialties	873	6.2%	11 733	9.0%	7.4%
Neurology	282	2.0%	2544	2.0%	11.1%
Neurological Surgery	112	0.8%	1375	1.1%	8.1%
Obstetrics and Gynecology	742	5.3%	5372	4.1%	13.8%
Ophthalmology	140	1.0%	1446	1.1%	9.7%
Orthopaedic Surgery	237	1.7%	3760	2.9%	6.3%
Pathology	401	2.8%	2334	1.8%	17.2%
Pediatrics	1163	8.3%	9063	7.0%	12.8%
Pediatrics subspecialties	371	2.0%	3874	3.0%	9.6%
Physical Medicine and Rehabilitation	135	1.0%	1324	1.0%	10.2%
Psychiatry	770	5.5%	5619	4.3%	13.7%
Radiology	386	2.7%	4769	3.7%	8.1%
Urology	119	0.8%	1276	1.0%	9.3%
Other surgical specialties and subspecialties	295	2.1%	3772	2.9%	7.8%
Other specialties, subspecialties, and combined specialties	784	5.6%	11 181	8.6%	7.0%
Missing	429	3.0%	NA	NA	NA
Medical school education	Sample n	Sample proportion	Population N	Population proportion	Response rate
US/Canadian MD school	9036	64.1%	82 673	63.7%	10.9%
US Osteopathic school	1712	12.2%	15 459	11.9%	11.1%
Medical school outside of the US or Canada	2884	20.5%	31 587	24.4%	9.1%
Missing	456	3.2%	1	0.0%	NA