MAYO CLINIC

ORIGINAL ARTICLE

Physician Burnout, Well-being, and Work Unit Safety Grades in Relationship to Reported Medical Errors

Daniel S. Tawfik, MD, MS; Jochen Profit, MD, MPH; Timothy I. Morgenthaler, MD; Daniel V. Satele, MS; Christine A. Sinsky, MD; Liselotte N. Dyrbye, MD, MHPE; Michael A. Tutty, PhD; Colin P. West, MD, PhD; and Tait D. Shanafelt, MD

Abstract

Objective: To evaluate physician burnout, well-being, and work unit safety grades in relationship to perceived major medical errors.

Participants and Methods: From August 28, 2014, to October 6, 2014, we conducted a population-based survey of US physicians in active practice regarding burnout, fatigue, suicidal ideation, work unit safety grade, and recent medical errors. Multivariate logistic regression and mixed-effects hierarchical models evaluated the associations among burnout, well-being measures, work unit safety grades, and medical errors.

Results: Of 6695 responding physicians in active practice, 6586 provided information on the areas of interest: 3574 (54.3%) reported symptoms of burnout, 2163 (32.8%) reported excessive fatigue, and 427 (6.5%) reported recent suicidal ideation, with 255 of 6563 (3.9%) reporting a poor or failing patient safety grade in their primary work area and 691 of 6586 (10.5%) reporting a major medical error in the prior 3 months. Physicians reporting errors were more likely to have symptoms of burnout (77.6% vs 51.5%; $P<.001$), fatigue (46.6% vs 31.2%; $P<.001$), and recent suicidal ideation (12.7% vs 5.8%; $P<.001$). In multivariate modeling, perceived errors were independently more likely to be reported by physicians with burnout (odds ratio [OR], 2.22; 95% CI, 1.79-2.76) or fatigue (OR, 1.38; 95% CI, 1.15-1.65) and those with incrementally worse work unit safety grades (OR, 1.70; 95% CI, 1.36-2.12; OR, 1.92; 95% CI, 1.48-2.49; OR, 3.12; 95% CI, 2.13-4.58; and OR, 4.37; 95% CI, 2.06-9.28 for grades of B, C, D, and F, respectively), adjusted for demographic and clinical characteristics.

Conclusion: In this large national study, physician burnout, fatigue, and work unit safety grades were independently associated with major medical errors. Interventions to reduce rates of medical errors must address both physician well-being and work unit safety.

 ■ Mayo Clin Proc. 2018;■■(■):1-10

Medical errors are common in the US health care system. The 1999 Institute of Medicine report *To Err Is Human*[1] and subsequent studies[2-4] have cemented medical errors as a major source of inpatient deaths in the United States, responsible for about 100,000 to 200,000 deaths yearly. Serious nonfatal medical errors occur at 10- to 20-fold higher rates than fatal errors[5] and continue to remain prevalent despite widespread quality improvement efforts.[3,6,7]

Burnout and poor well-being have been recognized as common occupational hazards among health care professionals. Among US physicians, burnout prevalence is estimated at greater than 50%,[8] excessive fatigue is reported by 45%,[9] and the suicide rate is 3- to 5-fold higher than in the general population.[10,11]

Distress in health care professionals has been associated with patient safety events, including medical errors.[12] Most studies evaluating health care professional burnout and quality of care have found an inverse relationship,[13-19] although this finding has not been universal.[20-22] Poor physician well-being in other domains (eg, fatigue, depression, poor quality of life) has been linked to reduced patient safety

From the Division of Pediatric Critical Care Medicine, Department of Pediatrics (D.S.T.), Department of Health Research and Policy (D.S.T.), Perinatal Epidemiology and Health Outcomes Research Unit, Division of Neonatal and Developmental Medicine, Department of Pediatrics (J.P.), and Department of

Affiliations continued at the end of this article.

in many,[16,18,22,23] but not all,[21,24] studies. Most reports have been cross-sectional observational studies, and a nuanced understanding of the potentially bidirectional connection between physician well-being and patient safety remains in its infancy.[25,26]

Safety grades provide a summary reflection of the patient safety practices of a work unit and have been operationalized at the hospital or work unit level through data-driven metrics, subjective assessments, or both.[27] The relationship between work unit safety grades and patient outcomes remains controversial, and the influence of physician well-being on this relationship is unknown.[28-30] A deeper understanding of the associations between physician well-being and patient safety may inform policies and system-based approaches to improve outcomes for physicians and their patients.

In the present study we sought to (1) describe burnout, fatigue, and depressive symptoms in relationship to medical errors in a large sample of US physicians and (2) evaluate the relationships between physician burnout and work unit safety grade in relationship to medical errors.

PARTICIPANTS AND METHODS

We conducted a cross-sectional, national survey of US physicians between August 28, 2014, and October 6, 2014.[31] A detailed description of the survey administration process, participation rates, and demographic characteristics has been published previously.[8,31] The physician sample for the survey was assembled using the American Medical Association's Physician Masterfile, a nearly complete record of all US physicians independent of American Medical Association membership, and included physicians of all specialty disciplines. The stated purpose of the study in the invitation was to better understand the factors that contribute to satisfaction in US physicians and did not specifically mention burnout, work unit safety, or medical errors. Participation was voluntary, and all responses were anonymous. Of the 35,922 physicians who opened an invitation, 6880 (19.2%) completed surveys, and evaluation for response bias by comparing early responders vs late responders suggested that the respondents were representative of all US physicians who received an invitation.[8] The demographic characteristics of participants relative to all 835,451 US physicians in the Physician Masterfile were generally similar, although participants were slightly older (median age, 56 years vs 51.5 years).[8] Among these 6880 participants, the 6695 (97.3%) in active clinical practice at the time of the survey were included in this analysis on burnout, well-being, work unit safety, and medical errors.

Study Measures

The survey included 60 questions. Responding physicians provided information regarding basic demographic (age, sex, and relationship status) and professional (specialty, practice setting, and hours worked per week) characteristics. Standardized survey tools were used to assess burnout[32] and well-being.[33-35]

Burnout and Well-being

Burnout was measured using the Maslach Burnout Inventory, a 22-item questionnaire considered the criterion standard for measuring burnout.[32,36,37] Consistent with convention,[38-40] we classified physicians with a high score on the depersonalization (DP) or emotional exhaustion (EE) subscale of the Maslach Burnout Inventory as having at least one manifestation of professional burnout.[37]

Fatigue was measured using a standardized linear analog self-assessment question. Respondents were asked to indicate their level of fatigue during the past week according to their own definition of the term on a 0 ("As bad as it can be") to 10 ("As good as it can be") scale. This item has been used in studies of physicians[40,41] and nonphysicians.[42] Excessive fatigue was defined as a score of 4 or lower on this scale, equivalent to one-half standard deviation below the mean of responses from a control population of 5392 employed nonphysicians. Characteristics of this control population have been previously described.[8]

Symptoms of depression were evaluated using the 2-item Primary Care Evaluation of Mental Disorders,[43] a standardized and validated form of depression screening that performs as well as longer instruments.[34] Recent suicidal ideation (SI) was evaluated by asking participants, "During the past 12

months, have you had thoughts of taking your own life?" This item measures somewhat recent, but not necessarily active, SI[44] and has been used in other studies of physicians[10,45] and nonphysicians.[46-48]

Work Unit Safety Grade and Medical Errors

An item derived from the Agency for Healthcare Research and Quality facility/hospital Survey on Patient Safety Culture was used to measure work unit safety grade based on perceived quality and safety in the work area where physicians practiced.[49] This item asked, "Please give the work area (clinic/hospital/other) where you spend most of your time an overall grade on patient safety." Response options were A (excellent), B (very good), C (acceptable), D (poor), and F (failing).

Recent, self-perceived medical errors were evaluated by asking physicians, "Are you concerned you have made any major medical errors in the last 3 months?" The question was based on similar measures from previous physician surveys[18,19,40] and is intended to identify recent events internalized as a major medical error; events identified in this way have been found to have a high correlation with actual medical errors.[50] For those who answered "yes," 2 follow-up questions were asked: "Which of the following best describes your most recent error?" and "What was the outcome of your most recent error?" Answer choices for these follow-up questions are shown in Table 1.

Statistical Analyses

Standard descriptive summary statistics were used to characterize responses. Associations between variables were evaluated using the Kruskal-Wallis test (continuous variables) or χ^2 test (categorical variables) as appropriate. All tests were 2-sided with type I error rates of 0.05. Multivariate logistic regression was performed to identify characteristics independently associated with whether a recent, self-perceived medical error was reported. Mixed-effects hierarchical modeling was employed to account for respondent characteristics nested within specialties. The logistic regression model was bootstrapped to evaluate its robustness, using 1000 iterations of 6695 observations sampled randomly with replacement. All analyses were performed using SAS statistical software, version 9 (SAS Institute).

LIMITATIONS

This study must be interpreted in the context of this design. As a cross-sectional study, it cannot determine the causality of the observed associations. Although our primary outcome of physician-identified adverse events may differ from events identified by retrospective medical record review, they have shown high correlation with recorded events[50] and may even be more likely to represent truly preventable medical errors.[51] Participation in this study was voluntary and thus susceptible to response bias. However, the observable demographic characteristics of the sample were well-aligned with the complete population of US physicians, and early vs late responders did not meaningfully differ,[8] suggesting that this study carries relevance for the population of physicians as a whole.

RESULTS

Of the 35,922 physicians who opened the invitation, 6695 physicians in active clinical practice completed the survey. As previously reported, respondents were similar to the overall US physician population from a demographic and specialty perspective.[8] Demographic characteristics of survey respondents are shown in the the Supplemental Table (available online at http://www.mayoclinicproceedings.org). A total of 4355 of 6490 (67%) respondents were male (205 respondents did not report sex), with a median age of 56 (interquartile range [IQR], 45-63) years, median of 50 (IQR, 40-60) hours worked per week, and a median of 1 (IQR, 0-3) nights on call per week.

Of 6586 respondents, 691 (10.5%) reported a self-perceived major medical error in the previous 3 months, as shown in Table 1. Errors were most commonly categorized as an error in judgment (266 of 679 respondents [39.2%]), wrong diagnosis (136 of 679 [20.0%]), or technical mistake (88 of 679 [13.0%]). More than half of all errors (367 of 663 respondents [55.4%]) had no perceived effect on patient outcome, but 35 (5.3%) resulted in "significant permanent morbidity" and 30 (4.5%) in a patient death. The highest prevalence of medical errors was

TABLE 1. Recent Perceived Major Medical Errors and Work Unit Safety Grades[a]

Variable	All respondents (N=6695)
Major medical error in last 3 months	691 (10.5)
Description of most recent error[b]	679 (10.1)
Error in judgment	266 (39.2)
Wrong diagnosis	136 (20.0)
Technical mistake during procedure	88 (13.0)
Prescribed wrong drug/dosage	55 (8.1)
Ordered medication/intervention for wrong patient	25 (3.7)
Other	109 (16.1)
Outcome of most recent error[b]	663 (9.9)
No effect on patient outcome	367 (55.4)
Caused minor temporary morbidity	150 (22.6)
Caused minor permanent morbidity	13 (2.0)
Caused major temporary morbidity	68 (10.3)
Caused major permanent morbidity	35 (5.3)
Patient died	30 (4.5)
Work unit safety grade	6563 (98.0)
A (excellent)	2492 (38.0)
B (very good)	2678 (40.8)
C (acceptable)	1138 (17.3)
D (poor)	215 (3.3)
F (failing)	40 (0.6)

[a]Data are presented as No. (percentage) of participants who provided information.
[b]Asked of those reporting major medical error in the past 3 months.

reported by respondents from radiology (58 of 249 respondents [23.3%]), neurosurgery (12 of 55 [21.8%]), and emergency medicine (74 of 346 [21.4%]), as shown in Supplemental Figure 1 (available online at http://www.mayoclinicproceedings.org).

Table 2 reports symptoms of burnout, fatigue, quality of life, suicidal ideation, and depressive symptoms among survey respondents. Among the 6586 participants who provided information on these symptoms, 3066 (47.2%) had high EE, 2270 (35.1%) had high DP, and 1033 (16.1%) had low personal accomplishment (PA). A total of 3574 (54.3%) had a high score on EE and/or DP and were categorized as having at least one symptom of burnout. The 691 physicians who reported errors had a higher prevalence of overall burnout than the 5895 who did not report errors (536 [77.6%] vs 3038 [51.5%], respectively; $P<.001$), as well as higher rates of high EE (464 [68.1%] vs 2602 [44.7%], respectively; $P<.001$), high DP (414 [61.1%] vs 1856 [32.0%], respectively; $P<.001$), and low PA (176 [26.3%] vs 857 [14.9%], respectively; $P<.001$). As shown in Supplemental Figure 2 (available online at http://www.mayoclinicproceedings.org), increased EE and DP scores were associated with increased prevalence of self-reported medical errors. High levels of fatigue were reported by 2163 of the 6586 respondents who provided information on symptoms of burnout (32.8%), with higher prevalence among the 691 who reported errors than among the 5895 who did not report errors (322 [46.6%] vs 1841 [31.2%], respectively; $P<.001$). Suicidal ideation within the past year was reported by 427 respondents (6.5%), with physicians reporting recent errors having a higher prevalence of SI (88 [12.7%] vs 339 [5.8%], respectively; $P<.001$).

As shown in Table 2, univariate logistic regressions revealed increased odds of perceived medical error for each 1-point increase in EE (odds ratio [OR], 1.05; 95% CI, 1.04-1.05) or DP (OR, 1.10; 95% CI, 1.09-1.12), and each 1-point decrease in PA (OR, 0.95; 95% CI, 0.94-0.96). Increased odds of perceived medical error was also inversely associated with each 1-point change in overall quality of life (OR, 0.81; 95% CI, 0.78-0.84). Higher odds of perceived medical error were associated with fatigue (OR, 1.92; 95% CI, 1.64-2.25), recent SI (OR, 2.40; 95% CI, 1.87-3.08), and depressive symptoms (OR, 2.76; 95% CI, 2.35-3.25).

Self-reported medical errors were inversely associated with work unit safety grades. Of the 255 physicians reporting either a poor (D) or failing (F) work unit safety grade, 63 (24.7%) reported a recent error. Error prevalence was incrementally lower for work unit safety grades of C (168 of 1129 [14.9%]), B (301 of 2653 [11.3%]), and A (148 of 2468 [6.0%]). The association persisted when stratified for physicians with and without burnout, as shown in the Figure.

Multivariate regressions demonstrated that burnout, fatigue, and lower work unit safety grades were each independently associated with self-reported medical errors, after adjustment for age, sex, workload, and specialty, as shown in Table 3. Odds of self-reported medical error were higher for physicians with burnout (OR, 2.22; 95% CI, 1.79-2.76) and for physicians with fatigue (OR, 1.38; 95% CI, 1.15-1.65). Compared with a work unit safety grade of A, odds ratios of self-reported medical error

TABLE 2. Burnout, Well-being, and Prevalence of Perceived Major Medical Errors Among 6695 Participants[a]

Variable	All (N=6586 [98.4%])	Recent error (n=691 [10.5%])	No recent error (n=5895 [89.5%])	Odds ratio (95% CI)[b]
Burnout				
Emotional exhaustion (scale 0-54; n=6501)[c]				1.05 (1.04-1.05)
Median score	25.0	34.0	24.0	
Low score	2182 (33.6)	100 (14.7)	2082 (35.8)	
Intermediate score	1253 (19.3)	117 (17.2)	1136 (19.5)	
High score	3066 (47.2)	464 (68.1)	2602 (44.7)	
Depersonalization (scale 0-30; n=6476)[d]				1.10 (1.09-1.12)
Median score	7.0	12.0	6.0	
Low score	2827 (43.6)	131 (19.3)	2696 (46.5)	
Intermediate score	1379 (21.3)	133 (19.6)	1246 (21.5)	
High score	2270 (35.1)	414 (61.1)	1856 (32.0)	
Personal accomplishment (scale 0-48; n=6419)[e]				0.95 (0.94-0.96)
Median score	41.0	38.0	42.0	
High score	3944 (61.4)	295 (44.0)	3649 (63.5)	
Intermediate score	1442 (22.5)	199 (29.7)	1243 (21.6)	
Low score	1033 (16.1)	176 (26.3)	857 (14.9)	
Participants with burnout[f]	3574 (54.3)	536 (77.6)	3038 (51.5)	3.33 (2.76-4.03)
Quality of life[g]				0.81 (0.78-0.84)
Median	8.0	7.0	8.0	
Fatigue[h]	2163 (32.8)	322 (46.6)	1841 (31.2)	1.92 (1.64-2.25)
Suicidal ideation	427 (6.5)	88 (12.7)	339 (5.8)	2.40 (1.87-3.08)
Depressive symptoms	2634 (40.0)	430 (62.2)	2204 (37.4)	2.76 (2.35-3.25)

[a]Data are presented as No. (percentage) of participants who provided information on symptoms of burnout. Percentages may not total 100 because of rounding.
[b]Odds of perceived major medical error associated with 1-point change in scale for burnout subscales and quality of life measurements and with positive response (vs not) for burnout, fatigue, suicidal ideation, and depressive symptoms.
[c]Denominators are 681 with recent error and 5820 with no recent error.
[d]Denominators are 678 with recent error and 5798 with no recent error.
[e]Denominators are 670 with recent error and 5749 with no recent error.
[f]High score on emotional exhaustion and/or depersonalization scale.
[g]Linear analog scale (0-10).
[h]Low score (0-4) on a 0-10 linear analog scale ($^1/_2$ standard deviation below the mean of a normative sample).

were 1.70 for work unit safety grade of B (95% CI, 1.36-2.12), 1.92 for grade C (95% CI, 1.48-2.49), 3.12 for grade D (95% CI, 2.13-4.58), and 4.37 for grade F (95% CI, 2.06-9.28). Results were consistent regardless of the form of multivariate modeling employed (logistic vs mixed-effects hierarchical).

As shown in Table 3, the odds of perceived medical errors also decreased by 1% for each year of increased age (OR, 0.99; 95% CI, 0.98-1.00) and increased by 4% for each additional night on call per week (OR, 1.04; 95% CI, 1.00-1.08). Respondent sex and work hours per week were not independently associated with errors. Radiology and emergency medicine retained their associations with higher self-reported medical error rates in multivariate analysis, whereas pediatric subspecialties, psychiatry, and anesthesiology were associated with a lower prevalence of perceived medical errors. With bootstrap sampling, significant associations with errors were observed for burnout in 100% of models, for safety grades in 100% of models, for fatigue in 95.6% of models, for age in 81.7% of models, and for nights on call in 55.1% of models.

DISCUSSION

In this large national study of US physicians across all specialties, burnout, well-being, and work unit safety grades were strongly and independently associated with perceived major medical errors. More than 10% of respondents reported a perceived major medical error in the prior 3 months, consistent with prior studies,[18,19] and the roughly 5% fatality rate reported as resulting from these errors supports previous estimates that 90% to 95% of major medical errors are not fatal.[5]

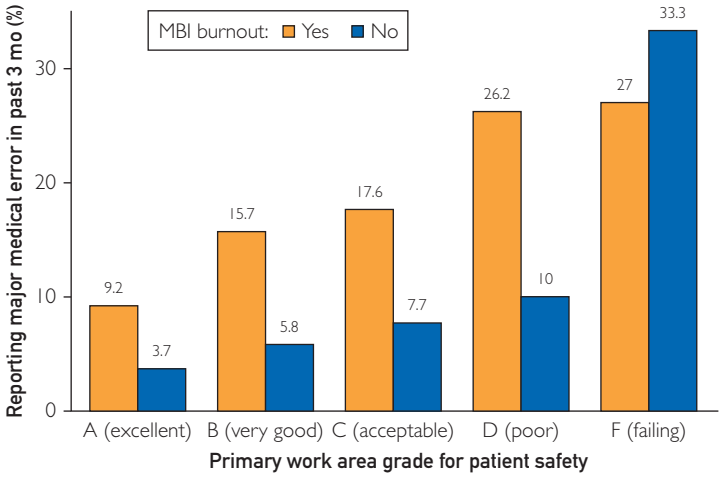

FIGURE. Work unit safety grade and prevalence of perceived major medical error, stratified by respondent burnout status. MBI = Maslach Burnout Inventory.

Our findings support several other studies that have reported an association between physician burnout and adverse quality of care, including self-reported errors.[14-17,41,52-56] The cross-sectional observational nature of these studies limits firm conclusions regarding any directionality of the relationship, but it is conceptually likely that the two are reciprocal. Indeed, this hypothesis is supported by the two longitudinal studies by West et al[18,23] performed in internal medicine residents. In prospective analysis, self-perceived medical errors were found to predict subsequent burnout, while burnout was also found to predict subsequent perceived medical errors.

The strong dose-response associations between burnout subscale scores and perceived medical errors in a national sample of US physicians across all specialties is consistent with prior single-specialty studies[19] and single-center studies of residents,[18,23] supporting the universality of the underlying construct associating burnout and impaired quality of care among all specialties. The odds of error increased by 5% for each 1-point increase in EE (on a 54-point scale, consistent with prior studies reporting 5%-7% increases), by 10% for each 1-point increase in DP (on a 33-point scale, consistent with prior studies reporting 9%-11%), and by 5% for each 1-point decrease in PA (on a 48-point scale, consistent with prior studies reporting 4%-7%).[18,19,23]

The linear nature of these relationships in all of these studies indicates that the common dichotomization into "burned out" vs "not burned out" provides an incomplete understanding of the full effects of burnout on quality of care delivery. The burnout metrics employed in this study are on 30- to 54-point scales, but even 1-point differences in scores carry relevance across the continuum (eg, even among those with low exhaustion/depersonalization or high personal accomplishment). This phenomenon argues that the observed association between burnout and errors is not merely attributable to individuals falling at the extremes of the burnout spectrum. It also suggests that efforts to improve physician well-being need to reduce the degree of burnout across the full continuum (eg, reducing mean scores) rather than trying to simply reduce the proportion of physicians with high burnout scores in one or more domains.

Fatigue was also found to be associated with recent perceived medical errors in the present study of practicing US physicians across all specialties, expanding on prior studies by West et al[23] and Gander et al,[57] which found similar associations among internal medicine residents and anesthesiologists, respectively. Although less common than burnout, symptoms of depression and suicidality were also strongly associated with perceived medical errors in our physician cohort. Blame-related distress among physicians following adverse patient outcomes, termed *second victim syndrome*, commonly manifests as depression and suicidality in addition to frustration, anxiety, burnout, and intent to leave medical practice.[58-62] The support systems for second victims remain underdeveloped in many practice settings, and our findings suggest that increased support may be needed for physicians involved in medical errors.[19,58,59] Conversely, depression and suicidality are well described among physicians in general and conceptually likely to affect job performance and predispose toward subsequent errors.[10,11] Depression among internal medicine residents and surgeons has been linked to a 90% to 220% increase in the odds of subsequent self-reported medical error in longitudinal studies.[18,19,23] Our finding of an association

TABLE 3. Multivariate Analysis of Factors Associated With Perceived Major Medical Errors

Model	Predictor	Odds ratio (95% CI)[a]	*P* value
Multivariate logistic regression[b]	Burnout present (vs absent)	2.22 (1.79-2.76)	<.001
	Fatigued (vs not)	1.38 (1.15-1.65)	<.001
	Work unit safety grade (vs A)		
	Grade B	1.70 (1.36-2.12)	<.001
	Grade C	1.92 (1.48-2.49)	<.001
	Grade D	3.12 (2.13-4.58)	<.001
	Grade F	4.37 (2.06-9.28)	<.001
	Age (for each year older)	0.99 (0.98-1.00)	.009
	Nights on call per week (for each night)	1.04 (1.00-1.08)	.05
	Specialty (vs Internal Medicine)[c]		
	Radiology	2.58 (1.66-4.03)	<.001
	Emergency medicine	1.82 (1.20-2.74)	.005
	Anesthesiology	0.52 (0.27-1.00)	.05
	Psychiatry	0.50 (0.30-0.82)	.007
	Pediatric subspecialty	0.49 (0.26-0.89)	.02
Mixed effect hierarchical[b,d]	Burnout present (vs absent)	2.26 (1.82-2.80)	<.001
	Fatigued (vs not)	1.38 (1.15-1.65)	<.001
	Work unit safety grade (vs A)		
	Grade B	1.71 (1.37-2.13)	<.001
	Grade C	1.95 (1.51-2.52)	<.001
	Grade D	3.31 (2.26-4.83)	<.001
	Grade F	4.29 (2.01-9.14)	<.001
	Age (for each year older)	0.98 (0.98-0.99)	<.001
	Nights on call per week (for each night)	1.04 (1.00-1.08)	.04

[a]Odds of perceived major medical error.
[b]Variables also included in the model: sex, hours worked per week.
[c]Specialties not listed had no independent association.
[d]Treating specialty as a random effect.

between depression/suicidality and medical errors among physicians across all specialties underscores the urgency for addressing physician mental health among the medical community as a whole. Robust programs to support physicians dealing with distress and/or medical errors have been described.[63,64]

Although the majority (approximately 80%) of physicians in the current study graded the safety of their primary work area as either excellent or very good, roughly 4% of respondents reported either a poor or failing safety grade. Prior research has associated burnout with perceptions of poor safety climate,[65] but the current study found independent associations between poor work unit safety grade and medical errors as well as between burnout and medical errors, arguing against collinearity as the sole explanation for our findings. This phenomenon highlights that both a systems-based approach to improve work unit safety and a system approach to reduce burnout and improve well-being of health care workers are necessary to reduce errors and optimize safety/quality of care.

Based on the data presented in the Figure, a combination of physician-targeted burnout interventions and unit-targeted patient safety improvement measures (moving from D to C, etc) are needed in order to provide the most effective error prevention. Indeed the magnitude of errors attributable to physician burnout within a given work unit safety grade is similar to a 2- to 3-grade level worsening in overall work unit safety score. For example, the 9.2% prevalence of errors among physicians with burnout in a work unit with a safety grade of A is nearly 3 times that of a non—burned-out physician in a similarly graded work unit but is similar to a non—burned-out physician in a work unit with a safety grade of C or D. It should be noted that although most efforts to improve safety to date have primarily targeted system

safety factors, system efforts to improve well-being are also necessary to optimize safety.[66]

CONCLUSION

This study suggests that burnout, poor well-being, and low work unit safety grades are independently associated with increased odds of recent perceived major medical errors among US physicians. A multifaceted approach is needed to reduce medical errors, including interventions to improve unit-level patient safety infrastructure as well as system-level interventions combatting physician burnout and promoting well-being.

SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at http://www.mayoclinicproceedings.org. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: **DP** = depersonalization; **EE** = emotional exhaustion; **IQR** = interquartile range; **OR** = odds ratio; **PA** = personal accomplishment; **SI** = suicidal ideation

Affiliations (Continued from the first page of this article.): Medicine (T.D.S.), Stanford University School of Medicine, Stanford, CA; California Perinatal Quality Care Collaborative, Palo Alto, CA (J.P.); Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine (T.I.M.), Division of Biomedical Statistics and Informatics, Department of Health Sciences Research (D.V.S., C.P.W.), Department of Internal Medicine (L.N.D.), and Division of General Internal Medicine, Department of Internal Medicine (C.P.W.), Mayo Clinic, Rochester, MN; and American Medical Association, Chicago, IL (C.A.S., M.A.T.).

Grant Support: This work was supported by grants R01 HD084679-01 and K24 HD053771-01 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development and by the Mayo Clinic Program on Physician Well-being.

Potential Competing Interests: The authors report no conflicts of interest.

Correspondence: Address to Daniel S. Tawfik, MD, MS, Division of Pediatric Critical Care Medicine, Department of Pediatrics, Stanford University School of Medicine, 770 Welch Rd, Ste 435, Palo Alto, CA 94304.

REFERENCES

1. Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academy Press; 2000.
2. Makary MA, Daniel M. Medical error—the third leading cause of death in the US. *BMJ*. 2016;353:i2139.
3. Hogan H, Zipfel R, Neuburger J, Hutchings A, Darzi A, Black N. Avoidability of hospital deaths and association with hospital-wide mortality ratios: retrospective case record review and regression analysis. *BMJ*. 2015;351:h3239.
4. Shojania KG, Dixon-Woods M. Estimating deaths due to medical error: the ongoing controversy and why it matters. *BMJ Qual Saf*. 2017;26(5):423-428.
5. James JT. A new, evidence-based estimate of patient harms associated with hospital care. *J Patient Saf*. 2013;9(3):122-128.
6. Landrigan CP, Parry GJ, Bones CB, Hackbarth AD, Goldmann DA, Sharek PJ. Temporal trends in rates of patient harm resulting from medical care [published correction appears in *N Engl J Med*. 2010;363(26):2573]. *N Engl J Med*. 2010;363(22):2124-2134.
7. Vincent C, Aylin P, Franklin BD, et al. Is health care getting safer? *BMJ*. 2008;337:a2426.
8. Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014 [published correction appears in *Mayo Clin Proc*. 2016;91(2):276]. *Mayo Clin Proc*. 2015;90(12):1600-1613.
9. O'Donnell EP, Humeniuk KM, West CP, Tilburt JC. The effects of fatigue and dissatisfaction on how physicians perceive their social responsibilities. *Mayo Clin Proc*. 2015;90(2):194-201.
10. Shanafelt TD, Balch CM, Dyrbye L, et al. Special report: suicidal ideation among American surgeons. *Arch Surg*. 2011;146(1):54-62.
11. Center C, Davis M, Detre T, et al. Confronting depression and suicide in physicians: a consensus statement. *JAMA*. 2003;289(23):3161-3166.
12. Hall LH, Johnson J, Watt I, Tsipa A, O'Connor DB. Healthcare staff wellbeing, burnout, and patient safety: a systematic review. *PLoS One*. 2016;11(7):e0159015.
13. Cimiotti JP, Aiken LH, Sloane DM, Wu ES. Nurse staffing, burnout, and health care-associated infection [published correction appears in *Am J Infect Control*. 2012;40(7):680]. *Am J Infect Control*. 2012;40(6):486-490.
14. Tawfik DS, Sexton JB, Kan P, et al. Burnout in the neonatal intensive care unit and its relation to healthcare-associated infections. *J Perinatol*. 2017;37(3):315-320.
15. Welp A, Meier LL, Manser T. Emotional exhaustion and workload predict clinician-rated and objective patient safety. *Front Psychol*. 2014;5:1573.
16. de Oliveira GS Jr, Chang R, Fitzgerald PC, et al. The prevalence of burnout and depression and their association with adherence to safety and practice standards: a survey of United States anesthesiology trainees. *Anesth Analg*. 2013;117(1):182-193.
17. Shanafelt TD, Bradley KA, Wipf JE, Back AL. Burnout and self-reported patient care in an internal medicine residency program. *Ann Intern Med*. 2002;136(5):358-367.
18. West CP, Huschka MM, Novotny PJ, et al. Association of perceived medical errors with resident distress and empathy: a prospective longitudinal study. *JAMA*. 2006;296(9):1071-1078.
19. Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. *Ann Surg*. 2010;251(6):995-1000.
20. Kwah J, Weintraub J, Fallar R, Ripp J. The effect of burnout on medical errors and professionalism in first-year internal medicine residents. *J Grad Med Educ*. 2016;8(4):597-600.
21. Linzer M, Manwell LB, Williams ES, et al. Working conditions in primary care: physician reactions and care quality. *Ann Intern Med*. 2009;151(1):28-36. W6-W9.
22. Garrouste-Orgeas M, Perrin M, Soufir L, et al. The iatroref study: medical errors are associated with symptoms of

depression in ICU staff but not burnout or safety culture. *Intensive Care Med*. 2015;41(2):273-284.
23. West CP, Tan AD, Habermann TM, Sloan JA, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. *JAMA*. 2009;302(12):1294-1300.
24. Baldwin PJ, Dodd M, Wrate RW. Young doctors' health—I. How do working conditions affect attitudes, health and performance? *Soc Sci Med*. 1997;45(1):35-40.
25. Heyhoe J, Birks Y, Harrison R, O'Hara JK, Cracknell A, Lawton R. The role of emotion in patient safety: are we brave enough to scratch beneath the surface? *J R Soc Med*. 2016;109(2):52-58.
26. Croskerry P, Abbass A, Wu AW. Emotional influences in patient safety. *J Patient Saf*. 2010;6(4):199-205.
27. Austin JM, D'Andrea G, Birkmeyer JD, et al. Safety in numbers: the development of Leapfrog's composite patient safety score for U.S. hospitals. *J Patient Saf*. 2014;10(1):64-71.
28. Pakyz AL, Wang H, Ozcan YA, Edmond MB, Vogus TJ. Leapfrog Hospital Safety Score, Magnet designation, and healthcare-associated infections in United States hospitals [published online ahead of print April 27, 2017]. *J Patient Saf*. https://doi.org/10.1097/PTS.0000000000000378.
29. Smith SN, Reichert HA, Ameling JM, Meddings J. Dissecting Leapfrog: how well do Leapfrog Safe Practices Scores correlate with hospital compare ratings and penalties, and how much do they matter? *Med Care*. 2017;55(6):606-614.
30. Gonzalez AA, Ghaferi AA. Hospital Safety Scores: do grades really matter? *JAMA Surg*. 2014;149(5):413-414.
31. Shanafelt TD, Dyrbye LN, Sinsky C, et al. Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. *Mayo Clin Proc*. 2016;91(7):836-848.
32. Maslach C, Jackson SE, Leiter MP. *Maslach Burnout Inventory Manual*. 3rd ed. Palo Alto, CA: Consulting Psychologists Press; 1996.
33. Ware JE, Kosinski M, Turner-Bowker DM, Gandek B. *How to Score Version 2 of the SF-12 Health Survey*. Lincoln, RI: QualityMetric Inc; 2002.
34. Whooley MA, Avins AL, Miranda J, Browner WS. Case-finding instruments for depression: two questions are as good as many. *J Gen Intern Med*. 1997;12(7):439-445.
35. Ware J Jr, Kosinski M, Keller SD. A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. *Med Care*. 1996;34(3):220-233.
36. Rafferty JP, Lemkau JP, Purdy RR, Rudisill JR. Validity of the Maslach Burnout Inventory for family practice physicians. *J Clin Psychol*. 1986;42(3):488-492.
37. Lee RT, Ashforth BE. A meta-analytic examination of the correlates of the three dimensions of job burnout. *J Appl Psychol*. 1996;81(2):123-133.
38. West CP, Dyrbye LN, Satele DV, Sloan JA, Shanafelt TD. Concurrent validity of single-item measures of emotional exhaustion and depersonalization in burnout assessment. *J Gen Intern Med*. 2012;27(11):1445-1452.
39. West CP, Shanafelt TD, Kolars JC. Quality of life, burnout, educational debt, and medical knowledge among internal medicine residents. *JAMA*. 2011;306(9):952-960.
40. West CP, Dyrbye LN, Sloan JA, Shanafelt TD. Single item measures of emotional exhaustion and depersonalization are useful for assessing burnout in medical professionals. *J Gen Intern Med*. 2009;24(12):1318-1321.
41. Dyrbye LN, Satele D, Sloan J, Shanafelt TD. Utility of a brief screening tool to identify physicians in distress. *J Gen Intern Med*. 2013;28(3):421-427.
42. Dyrbye LN, Satele D, Sloan J, Shanafelt TD. Ability of the Physician Well-Being Index to identify residents in distress. *J Grad Med Educ*. 2014;6(1):78-84.
43. Spitzer RL, Williams JB, Kroenke K, et al. Utility of a new procedure for diagnosing mental disorders in primary care: the PRIME-MD 1000 study. *JAMA*. 1994;272(22):1749-1756.
44. Buchbinder SB, Wilson M, Melick CF, Powe NR. Primary care physician job satisfaction and turnover. *Am J Manag Care*. 2001;7(7):701-713.
45. Shanafelt TD, Boone S, Tan L, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. *Arch Intern Med*. 2012;172(18):1377-1385.
46. Kessler RC, Berglund P, Borges G, Nock M, Wang PS. Trends in suicide ideation, plans, gestures, and attempts in the United States, 1990-1992 to 2001-2003. *JAMA*. 2005;293(20):2487-2495.
47. Kessler RC, Borges G, Walters EE. Prevalence of and risk factors for lifetime suicide attempts in the National Comorbidity Survey. *Arch Gen Psychiatry*. 1999;56(7):617-626.
48. Cooper-Patrick L, Crum RM, Ford DE. Identifying suicidal ideation in general medical patients. *JAMA*. 1994;272(22):1757-1762.
49. Hospital Survey on Patient Safety Culture. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/sops/quality-patient-safety/patientsafetyculture/hospital/index.html. Accessed June 13, 2018.
50. Weingart SN, Callanan LD, Ship AN, Aronson MD. A physician-based voluntary reporting system for adverse events and medical errors. *J Gen Intern Med*. 2001;16(12):809-814.
51. O'Neil AC, Petersen LA, Cook EF, Bates DW, Lee TH, Brennan TA. Physician reporting compared with medical-record review to identify adverse medical events. *Ann Intern Med*. 1993;119(5):370-376.
52. Hayashino Y, Utsugi-Ozaki M, Feldman MD, Fukuhara S. Hope modified the association between distress and incidence of self-perceived medical errors among practicing physicians: prospective cohort study. *PLoS One*. 2012;7(4):e35585.
53. Chen KY, Yang CM, Lien CH, et al. Burnout, job satisfaction, and medical malpractice among physicians. *Int J Med Sci*. 2013;10(11):1471-1478.
54. Prins JT, van der Heijden FM, Hoekstra-Weebers JE, et al. Burnout, engagement and resident physicians' self-reported errors. *Psychol Health Med*. 2009;14(6):654-666.
55. Williams ES, Manwell LB, Konrad TR, Linzer M. The relationship of organizational culture, stress, satisfaction, and burnout with physician-reported error and suboptimal patient care: results from the MEMO study. *Health Care Manage Rev*. 2007;32(3):203-212.
56. Fahrenkopf AM, Sectish TC, Barger LK, et al. Rates of medication errors among depressed and burnt out residents: prospective cohort study. *BMJ*. 2008;336(7642):488-491.
57. Gander PH, Merry A, Millar MM, Weller J. Hours of work and fatigue-related error: a survey of New Zealand anaesthetists. *Anaesth Intensive Care*. 2000;28(2):178-183.
58. Marmon LM, Heiss K. Improving surgeon wellness: the second victim syndrome and quality of care. *Semin Pediatr Surg*. 2015;24(6):315-318.
59. Lewis EJ, Baernholdt MB, Yan G, Guterbock TG. Relationship of adverse events and support to RN burnout. *J Nurs Care Qual*. 2015;30(2):144-152.
60. Davidson JE, Agan DL, Chakedis S. Exploring distress caused by blame for a negative patient outcome. *J Nurs Adm*. 2016;46(1):18-24.
61. O'Beirne M, Sterling P, Palacios-Derflingher L, Hohman S, Zwicker K. Emotional impact of patient safety incidents on family physicians and their office staff. *J Am Board Fam Med*. 2012;25(2):177-183.

62. Van Gerven E, Vander Elst T, Vandenbroeck S, et al. Increased risk of burnout for physicians and nurses involved in a patient safety incident. *Med Care*. 2016; 54(10):937-943.
63. Shapiro J, Galowitz P. Peer support for clinicians: a programmatic approach. *Acad Med*. 2016;91(9):1200-1204.
64. Shanafelt T, Lightner DJ, Conley CR, et al. An organization model to assist individual physicians, scientists, and senior health care administrators with personal and professional needs. *Mayo Clin Proc*. 2017;92(11):1688-1696.
65. Profit J, Sharek PJ, Amspoker AB, et al. Burnout in the NICU setting and its relation to safety culture. *BMJ Qual Saf*. 2014;23(10):806-813.
66. Sexton JB, Sharek PJ, Thomas EJ, et al. Exposure to Leadership WalkRounds in neonatal intensive care units is associated with a better patient safety culture and less caregiver burnout. *BMJ Qual Saf*. 2014;23(10):814-822.

Mayo Clin Proc. ■ XXX 2018;■■(■):1-10 ■ https://doi.org/10.1016/j.mayocp.2018.05.014
www.mayoclinicproceedings.org