

Burnout and Suicidal Ideation among U.S. Medical Students

Liselotte N. Dyrbye, MD; Matthew R. Thomas, MD; F. Stanford Massie, MD; David V Power, MD; Anne Eacker, MD; William Harper, MD; Steven Durning, MD; Christine Moutier, MD; Daniel W. Szydlo, BA; Paul J. Novotny, MS; Jeff A. Sloan, PhD; and Tait D. Shanafelt, MD

Background: Little is known about the prevalence of suicidal ideation among U.S. medical students or how it relates to burnout.

Objective: To assess the frequency of suicidal ideation among medical students and explore its relationship with burnout.

Design: Cross-sectional 2007 and longitudinal 2006 to 2007 cohort study.

Setting: 7 medical schools in the United States.

Participants: 4287 medical students at 7 medical schools, with students at 5 institutions studied longitudinally.

Measurements: Prevalence of suicidal ideation in the past year and its relationship to burnout, demographic characteristics, and quality of life.

Results: Burnout was reported by 49.6% (95% CI, 47.5% to 51.8%) of students, and 11.2% (CI, 9.9% to 12.6%) reported suicidal ideation within the past year. In a sensitivity analysis that assumed all nonresponders did not have suicidal ideation, the prevalence of suicidal ideation in the past 12 months would be 5.8%. In the longitudinal cohort, burnout ($P < 0.001$ for all domains),

quality of life ($P < 0.002$ for each domain), and depressive symptoms ($P < 0.001$) at baseline predicted suicidal ideation over the following year. In multivariable analysis, burnout and low mental quality of life at baseline were independent predictors of suicidal ideation over the following year. Of the 370 students who met criteria for burnout in 2006, 99 (26.8%) recovered. Recovery from burnout was associated with markedly less suicidal ideation, which suggests that recovery from burnout decreased suicide risk.

Limitation: Although response rates (52% for the cross-sectional study and 65% for the longitudinal cohort study) are typical of physician surveys, nonresponse by some students reduces the precision of the estimated frequency of suicidal ideation and burnout.

Conclusion: Approximately 50% of students experience burnout and 10% experience suicidal ideation during medical school. Burnout seems to be associated with increased likelihood of subsequent suicidal ideation, whereas recovery from burnout is associated with less suicidal ideation.

Ann Intern Med. 2008;149:334-341.

www.annals.org

For author affiliations, see end of text.

Death by suicide is a major occupational hazard for physicians (1). The suicide rate among male physicians is more than 40% higher than among men in the general population, whereas that of female physicians is a staggering 130% higher than among women in the general population (1, 2). The increased risk for suicide among physicians may begin during medical school (3). Available studies suggest that the suicide rate among medical students is higher than in the age-matched population (3–5). Other small, single-institution studies (6–10) have reported that 3% to 15% of medical students have suicidal ideation during medical school training. Suicidal ideation is a well-established predictor of suicidal planning and attempts. The National Comorbidity Survey found that 34% of individuals in the general population with suicidal ideation develop a suicide plan and, of those who plan, more than 70% will attempt suicide (11). Notably, 26% of individuals with suicidal ideation progressed directly to an unplanned suicide attempt (11).

Suicide is at the extreme end of the personal distress continuum, and it is critical for medical schools to identify students at greatest risk for suicide in the hope of interven-

ing before a tragic outcome. Several multi-institutional studies (12–14) reveal that medical students have a substantially lower mental quality of life than similarly aged individuals in the general population and that burnout affects up to 50% of U.S. medical students.

We hypothesized that burnout would relate to suicidal ideation among medical students. We used a mixed longitudinal and cross-sectional study design to evaluate the prevalence of suicidal ideation among U.S. medical students and to evaluate the relationship between suicidal ideation and burnout, symptoms of depression, and quality of life. Our objective was to assess the frequency of suicidal ideation among medical students and explore its relationship with burnout.

METHODS

Participants

In the spring of 2006 (baseline) and 2007 (1-year follow-up), we invited all medical students at the Mayo Medical School, University of Washington School of Medicine, University of Chicago Pritzker School of Medicine, University of Minnesota Medical School, and University of Alabama School of Medicine to complete Web-based surveys. Students at the University of California San Diego School of Medicine and Uniformed Services University of the Health Sciences also participated in the 2007 survey. Participation was elective, and responses were anonymized. We included all students who responded to the 2007 survey in the cross-sectional analysis and those who responded

See also:

Web-Only

Conversion of graphics into slides

in both 2006 and 2007 in the longitudinal analysis. Each institution's institutional review board approved the study before participation of their students.

Data Collection

Participants returned the surveys electronically. Preserving student confidentiality was an essential feature. We linked individual responses on the 2006 and 2007 surveys for longitudinal analysis by using unique identifiers and stripped all data of identifiers before forwarding them to study statisticians for analysis.

Study Measures

We used established instruments to measure burnout, symptoms of depression, and quality of life on both the 2006 and 2007 surveys. These surveys also included questions about demographic characteristics, and the 2007 survey included questions about suicidal ideation.

Suicidal Ideation

We assessed suicidal ideation by asking students: "Have you ever had thoughts of taking your own life, even if you would not really do it?" "During the past 12 months have you had thoughts of taking your own life?" and "Have you ever made an attempt to take your own life?" These questions, which originated from an inventory developed by Meehan and colleagues (15) that has been used to assess suicidal ideation among medical students (9), are similar to questions used in large U.S. epidemiologic studies intended to assess suicidality (11, 16–18).

Burnout, Symptoms of Depression, and Quality of Life

The Maslach Burnout Inventory is a 22-item instrument that is considered the gold standard for measuring burnout (19–21). This instrument has separate subscales to evaluate each domain of burnout: emotional exhaustion, depersonalization, and low personal accomplishment. Tests of discriminant and convergent validity have been acceptable, construct validity of the 3 dimensions has been demonstrated (22, 23), and predictive validity has been suggested by burnout score predicting risk for future sick leave absences (24). The Maslach Burnout Inventory has also been used extensively in studies of both physicians (20, 21, 25) and medical students (13, 14, 26–28). According to convention, a score of 27 or higher on the emotional exhaustion subscale or 10 or higher on the depersonalization subscale was considered an indicator of professional burnout for medical professionals (19). Health professionals are considered to have a low score on the personal accomplishment scale if their score is 33 or less. Normal scores for health care professionals, including physicians, are 22.19, 7.12, and 36.53 on the emotional exhaustion, depersonalization, and personal accomplishment subscales, respectively (19).

We identified symptoms of depression by using the 2-item Primary Care Evaluation of Mental Disorders (29), a screening tool which performs as well as longer instruments (30). This instrument has a sensitivity of 86% to 96% and a specificity of 57% to 75% for major depressive

disorder (29, 30). With a reported positive likelihood ratio of up to 3.42 for the diagnosis of major depression (30) and an estimated 25% prevalence of depression among medical students (12), a positive result implies a 50% probability of current major depression.

We measured mental and physical quality of life by using the Medical Outcomes Study Short Form-8 (SF-8) (31, 32), an alternate version of the SF-36. Norm-based scoring methods of responses on this instrument are used to calculate mental and physical quality of life summary scores (31). The mean mental and physical quality of life summary scores for the U.S. population are 49.2 (SD, 9.46) and 49.2 (SD, 9.07), respectively (31). Previous research has demonstrated acceptable reliability and test-retest reliability (31). Several studies (31) have demonstrated content, construct, and criterion-related validity for the SF-8, and other studies (33) have demonstrated high convergent validity and good discriminate validity. The SF-8 has also been used in samples of residents (32) and medical students (14, 27, 28).

Statistical Analysis

Our primary analysis involved descriptive summary statistics for estimating the prevalence of suicidal ideation, burnout, a positive depression screen, and mental and physical quality of life for medical students. We evaluated differences by reported suicidal ideation in the previous year by using the Wilcoxon–Mann–Whitney test (for continuous variables) and the Fisher exact test (for categorical variables). We used the Wilcoxon rank-sum test rather than parametric tests to account for the interval level nature of the psychological tests. All tests were 2-sided, with a type I error rate of 0.05. We performed collinearity testing to determine whether multiple-way collinearity existed among the independent variables (34). No variables had achieved a level of collinearity that would bias the modeling process. We performed forward stepwise logistic regression to evaluate independent associations of the independent variables with suicidal ideation. We used a saturated model and backward stepping to confirm results of the initial stepwise regression. In all cases, backward stepping produced the same model as the stepwise approach. All analyses were done by using SAS, version 9 (SAS Institute, Cary, North Carolina).

Role of the Funding Source

This work was supported by an Education Innovation award from the Mayo Clinic. The Mayo Clinic played no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; or preparation of the manuscript or decision to publish the manuscript.

RESULTS

Cross-Sectional Survey

A total of 2248 (52.4%) of 4287 medical students responded to the 2007 survey. Responders were less likely than

Table 1. Participant Characteristics, 2007

Variable	Participants, n (%) (n = 2248)
Sex	
Male	1159 (51.8)
Female	1077 (48.2)
Missing*	12
Age, y	
<25	779 (34.8)
25–30	1229 (54.9)
>30	229 (10.2)
Missing*	11
Relationship status	
Married	731 (32.6)
Nonmarried partner	262 (11.7)
Single	1217 (54.3)
Divorced	31 (1.4)
Missing*	7
Have children	266 (11.9)
Year in medical school	
1st	623 (27.8)
2nd	578 (25.8)
3rd	494 (22.1)
4th	477 (21.3)
Other†	66 (2.9)
Missing*	10
Debt	
<\$50 000	1268 (56.8)
\$50 000–100 000	524 (23.5)
>\$100 000	439 (19.7)
Missing*	17

* The number of individuals who returned surveys but did not provide an answer to this specific question. Missing responses were excluded from the total before percentages were calculated.

† Students who took a break from medical school to pursue enrichment activities, such as research projects or graduate work.

the overall population to be male (51.6% vs. 54.9%), between 25 and 30 years of age (55.4% vs. 62.4%), or nonwhite (25.8% vs. 31.0%) (all $P < 0.02$). **Table 1** shows the demographic characteristics of cross-sectional survey respondents.

Table 2 shows the percentage of responders reporting suicidal ideation, burnout, and symptoms of depression and the mean quality-of-life scores. Of the 2230 responders on the 2007 survey who responded to questions on suicidal ideation, 249 (11.2% [CI, 9.9% to 12.6%]) reported considering suicide in the previous year and 43 (1.9% [CI, 1.4% to 2.6%]) had made a suicide attempt at some point in the past. On sensitivity analysis, assuming that all nonresponders did not have suicidal ideation, the prevalence of suicidal ideation in the past 12 months would be 249 (5.8%) of 4287 students.

Overall, 1069 (49.6%, [CI, 47.5%–51.8%]) of 2154 students met the criteria for burnout (94 students did not answer enough Maslach Burnout Inventory questions to be included in this analysis). Among these students, 860 (40.1%) of 2142 had high emotional exhaustion, 648 (31.8%) of 2037 had high depersonalization, and 595 of

1945 (30.6%) had a low sense of personal accomplishment. Compared with age-comparable individuals and the general U.S. population, medical students had lower mental quality-of-life scores (mean, 43.5 [SD, 11.0] vs. 47.2 [SD, 9.9] for age-comparable individuals [$P < 0.001$] and 49.2 [SD, 9.5] for the general U.S. population [$P < 0.001$]) but higher physical quality-of-life scores (mean, 52.2 [6.9] vs. 51.4 [SD, 7.9] for age-comparable individuals [$P < 0.001$] and 49.2 [SD, 9.1] for the general U.S. population [$P < 0.001$]) on the SF-8. More than one third of students (742 of 2178 [34.1%]) had mental quality-of-life scores less than 40, a score that is nearly a full standard deviation below the normal score for the general U.S. population.

Table 3 shows the likelihood of reporting suicidal ideation in the previous year, by demographic characteristics, burnout, depressive symptoms, and quality of life. Age, marital status, year in school, and debt were significantly associ-

Table 2. Burnout, Quality of Life, and Depression Symptoms, 2007

Variable	Participants (n = 2248) and Scores
Suicidality	
Ever considered suicide, n (%)	
Yes	561 (25.1)
No	1673 (74.9)
Missing*	14
Ever made suicide attempt, n (%)	
Yes	43 (1.9)
No	2184 (98.1)
Missing*	21
Considered suicide last year, n (%)	
Yes	249 (11.2)
No	1981 (88.8)
Missing*	18
Burnout†	
Mean emotional exhaustion score (SD) [range]	24.0 (10.9) [0–52]
Mean depersonalization score (SD) [range]	7.3 (5.9) [0–28]
Mean personal accomplishment score (SD) [range]‡	36.2 (7.7) [0–48]
Burned out	1069 (49.6)
Quality of life	
Mean mental score (SD)§	43.5 (11.0) [7.7–65.8]
Mean physical score (SD)	52.2 (6.9) [20.3–66.6]
Depression symptoms, n (%)	
Screen positive	1037 (46.5)
Screen negative	1191 (53.5)
Missing*	20

* The number of individuals who returned surveys but did not provide an answer to this specific question. Missing responses were excluded from the total before percentages were calculated.

† Burnout was measured by using the Maslach Burnout Inventory (19), whose 3 subscales evaluate each of the domains of burnout, characterized as emotional exhaustion, depersonalization, and low sense of personal accomplishment. A high score on either the emotional exhaustion (≥ 27) or depersonalization (≥ 10) subscale indicates professional burnout.

‡ A higher score is desirable and indicates greater sense of personal accomplishment.

§ The mean mental quality-of-life score for students was more than one-half standard deviation below the population norm, a difference that has been considered clinically significant.

Table 3. Demographic Characteristics and Distress among Medical Students with and without Suicidal Ideation in the Previous Year*

Variable	Suicidal Ideation	No Suicidal Ideation	Unadjusted Odds Ratio (95% CI) or Other Data
Sex, n (%)			
Male	122 (10.6)	1030 (89.4)	1.13 (0.87 to 1.47) [†]
Female	126 (11.8)	943 (88.2)	
Missing [‡]	1	8	
Age, n (%)			
<25 y	64 (8.3)	709 (91.7)	Reference [†]
25–30 y	156 (12.7)	1069 (87.3)	1.62 (1.19 to 2.20) [†]
>30 y	26 (11.6)	199 (88.4)	1.45 (0.89 to 2.34) [†]
Missing [‡]	3	4	
Relationship status, n (%)			
Single or divorced	153 (12.3)	1088 (87.7)	1.32 (1.01 to 1.73) [†]
Married or partner	95 (9.6)	891 (90.4)	
Missing [‡]	1	2	
Have children, n (%)			
Yes	38 (14.5)	225 (85.5)	1.41 (0.97 to 2.04) [†]
No	211 (10.7)	1754 (89.3)	
Year in medical school, n (%)			
First	50 (8.1)	568 (91.9)	Reference [†]
Second	67 (11.6)	509 (88.4)	1.50 (1.02 to 2.20) [†]
Third	67 (13.7)	423 (86.3)	1.80 (1.22 to 2.65) [†]
Fourth	61 (12.9)	413 (87.1)	1.68 (1.13 to 2.49) [†]
Other [§]	4 (6.1)	62 (93.9)	0.73 (0.26 to 2.10) [†]
Missing [‡]	0	6	
Debt, n (%)			
<\$49 999	125 (9.9)	1134 (90.1)	Reference [†]
\$50 000–\$99 999	62 (11.9)	459 (88.1)	1.23 (0.89 to 1.69) [†]
>\$100 000	61 (14.0)	376 (86.0)	1.47 (1.06 to 2.04) [†]
Missing [‡]	1	12	
Burnout			
Mean emotional exhaustion score (SD)	30.9 (10.54)	23.1 (10.55)	7.84 (6.42 to 9.26)
Mean depersonalization score (SD)	9.9 (6.61)	6.9 (5.74)	3.00 (2.10 to 3.89)
Mean personal accomplishment score (SD)	33.4 (8.24)	36.6 (7.49)	–3.23 (–4.35 to –2.10)
Have burnout, n (%)			
Yes	180 (16.9)	883 (83.1)	3.46 (2.55 to 4.69)
No	60 (5.6)	1017 (94.4)	
Quality of life			
Mean mental score (SD)	35.4 (11.30)	44.5 (10.50)	–9.09 (–10.62 to –7.57)
Mean physical score (SD)	50.9 (7.71)	52.4 (6.83)	–1.49 (–2.52 to –0.45)
Depression symptoms, n (%)			
Screen positive	203 (19.7)	828 (80.3)	6.51 (4.63 to 9.15)
Screen negative	43 (3.6)	1141 (96.4)	

* Of 2230 participants.

[†] Odds ratio for risk for suicidal ideation in the categorical group relative to the reference group. If there was >1 comparison group (for example, year in school), a reference group was selected to which all other groups were compared.

[‡] The number of individuals who returned surveys but did not provide an answer to this specific question. Missing responses were excluded from the total before percentages were calculated.

[§] Students who took a break from medical school to pursue enrichment activities, such as research projects or graduate work.

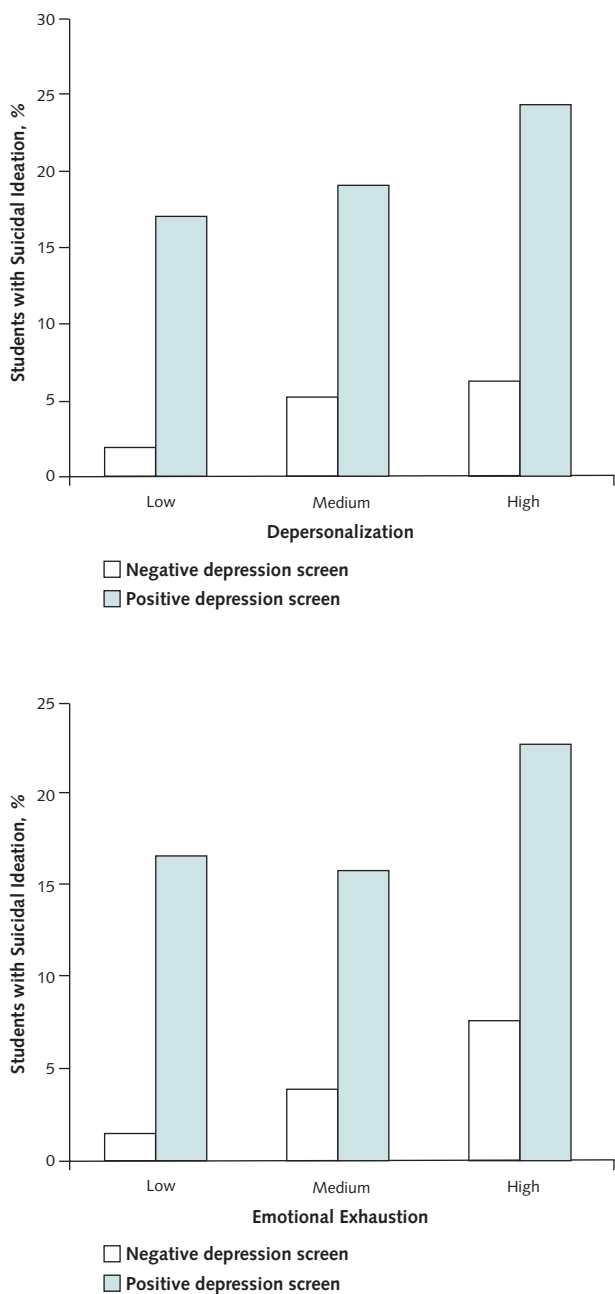
^{||} Mean difference.

ated with suicidal ideation in the previous year. We observed no association between sex and suicidal ideation.

Suicidal ideation was also strongly correlated with measures of distress and quality of life. Students were 2- to 3-fold more likely to report suicidal ideation if they had burnout (odds ratio, 3.46 [CI, 2.55 to 4.69]; $P < 0.001$),

high emotional exhaustion (odds ratio, 3.17 [CI, 2.39 to 4.19]; $P < 0.001$), high depersonalization (odds ratio, 2.10 [CI, 1.59 to 2.77]; $P < 0.001$), or a low sense of personal accomplishment (odds ratio, 2.03 [CI, 1.53 to 2.68]; $P < 0.001$). Students with suicidal ideation had statistically significantly lower mean mental (–9.09; $P < 0.001$) and

Figure 1. Prevalence of suicidal ideation, by degree of depersonalization and emotional exhaustion and depressive symptoms.



Relationship among depression screening result, degree of depersonalization or emotional exhaustion, and prevalence of suicidal ideation in the previous year ($n = 2248$). The prevalence of suicidal ideation increases as burnout increases (all $P < 0.001$), regardless of whether individuals screened positive for depression.

physical (-1.49 ; $P = 0.002$) quality-of-life scores on the SF-8. Students with depressive symptoms were more likely than those without depressive symptoms to endorse suicidal ideation (203 [19.7%] of 1031 vs. 43 [3.6%] of

1184; $P < 0.001$). Because of the strong association of both burnout and depression with suicidal ideation, we explored the interactions between these variables. The prevalence of suicidal ideation increased by severity of burnout independent of symptoms of depression (Figure 1).

Longitudinal Cohort

The response rate for the 2006 survey was 55% (13). Among the 1321 students who responded to the 2006 survey and were still enrolled in the same medical school, 858 (65%) also responded to the 2007 survey. The demographic characteristics of the individuals providing longitudinal data were similar to those for second- through fourth-year students in the 2007 cross-sectional cohort with respect to relationship status, parental status, year in school, and debt, although they were slightly more likely to be women (54% vs. 49%, $P = 0.006$) and be younger (9% vs. 12% older than 30 years; $P = 0.023$).

Table 4 shows the relationship among burnout, quality of life, and depressive symptoms at baseline with suicidal ideation over the ensuing year (spring 2006 to spring 2007). We observed a strong dose-response relationship between burnout and mental quality of life at baseline and suicidal ideation in the subsequent year. Each 1-point increase in emotional exhaustion and depersonalization scores and 1-point decrease in personal accomplishment scores was associated with a respective 5%, 10%, and 6% increase in the odds of suicidal ideation in the following year. Similarly, each 1-point decrease in mental quality of life was associated with a 7% increase in the odds of suicidal ideation over the subsequent year. When we classified burnout according to the standard categorical thresholds (low, intermediate, high) (19), high emotional exhaustion, high depersonalization, and low personal accomplishment at baseline were associated with a 1.83, 3.38, and 2.01

Table 4. Relationship of Burnout, Quality-of-Life Score, and Depression Symptoms at Baseline with Suicidal Ideation in the Following Year*

Variable	Univariate Odds Ratio (95% CI)†	P Value
Burnout		
Emotional exhaustion	1.05 (1.03–1.08)	<0.001
Depersonalization	1.10 (1.06–1.15)	<0.001
Personal accomplishment	1.06 (1.03–1.09)	<0.001
Burned out	2.33 (1.47–3.70)	<0.001
Quality of life		
Mental score	1.07 (1.05–1.09)	<0.001
Physical score	1.02 (0.99–1.05)	0.192
Positive for symptoms on depression screen	3.08 (1.91–4.97)	<0.001

* Of 858 participants.

† Odds ratios indicate the incremental increase in the likelihood of suicidal ideation associated with each 1-unit increase in emotional exhaustion and depersonalization scores or each 1-unit decrease in personal accomplishment or mental or physical quality-of-life score. The odds ratio of suicidal ideation for those with a positive depression screen is relative to those with a negative depression screen.

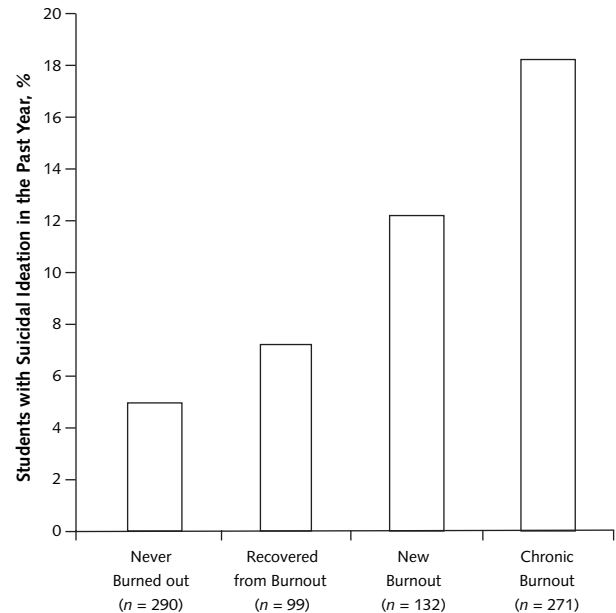
increased odds of suicidal ideation over the following year (all $P < 0.01$). Screening positive for depression at baseline was also associated with a 3-fold increase in suicidal ideation in the following year (odds ratio, 3.08 [CI, 1.91 to 4.97]; $P < 0.001$). No demographic characteristics (sex, age, relationship status, parental status, year in school, debt) were associated with future suicidal ideation (data not shown).

In stepwise multivariable logistic regression that controlled for variables associated with suicidal ideation on univariate analysis ($P < 0.100$) and medical school site, only the domains of burnout and mental quality of life remained independently associated with suicidal ideation. For each 1-point increase in depersonalization (odds ratio, 1.05; $P = 0.032$) or each 1-point decrease in personal accomplishment (odds ratio, 1.04; $P = 0.008$) or mental quality of life (odds ratio, 1.06; $P < 0.001$) at baseline, students were 4% to 6% more likely to experience suicidal ideation in the following year. Because a low score for depersonalization ranges from 0 to 5 (whereas a high score ranges from 10 to 30), the odds of suicidal ideation could increase between 25% and 150% as individuals move from low to high depersonalization. Similarly, because high personal accomplishment is characterized by a score from 40 to 48 and a low personal accomplishment score from 0 to 33, the odds of suicidal ideation could increase between 25% and 192% as individuals move from a high to low degree of personal accomplishment. The saturated multivariable modeling yielded similar results with respect to concordance and the amount of variability accounted.

Reversibility of Burnout

To further evaluate the relationship between burnout and suicidal ideation, we evaluated how changes in burnout between 2006 and 2007 related to suicidal ideation. At baseline, 370 (46.7%) of 792 students met criteria for burnout. (Seven hundred ninety-two of 858 students in the longitudinal cohort completed the Maslach Burnout Inventory adequately to be included in this analysis.) Of these 370 individuals, 271 (73.2%) remained burned out at 1 year follow-up (chronic burnout), whereas 99 (26.8%) were no longer burned out at 1 year follow-up (recovered from burnout). Among the 422 students who were not burned out at baseline, 132 (31.3%) experienced burnout at 1 year follow-up (new burnout), whereas the remaining 290 (68.7%) were not burned out at either time point (never burned out). **Figure 2** shows the prevalence of suicidal ideation among these groups. Students who recovered from burnout were less likely than students with chronic burnout to report suicidal ideation over the previous year (7.2% vs. 18.2%; $P = 0.001$) and had a rate of suicidal ideation similar to those who had never experienced burnout (7.2% vs. 4.9%; $P = 0.38$). Students who developed new burnout were as likely to report suicidal ideation in 2007 as students with chronic burnout (12.1% vs. 18.2%, $P = 0.120$). Students who never had burned out were less likely to report suicidal ideation than students with new burnout ($P = 0.007$) and chronic burnout ($P < 0.001$).

Figure 2. Prevalence of suicidal ideation, by burnout at 2 time points.



We found differences in suicidal ideation between groups ($P < 0.001$). Pairwise comparisons showed statistically significant differences between students who recovered versus students with chronic burnout ($P = 0.001$) and among students who never experienced burnout versus those with new burnout ($P = 0.007$) or chronic burnout ($P < 0.001$).

DISCUSSION

Our large, multi-institutional study demonstrates a high prevalence of recent suicidal ideation among U.S. medical students, with approximately 1 of 9 students having thoughts of suicide in the past year. The rate of suicidal ideation among medical students in our study (11.2%) is higher than for individuals of similar age in the general U.S. population (6.9% among 25- to 34-year-olds) (35). In our cohort, suicidal ideation had a strong relationship with both personal distress (quality of life and depressive symptoms) and professional distress (burnout). Although the relationship between depression and suicidal ideation is well recognized, the association between burnout and suicidal ideation has not been previously reported. This relationship is notable because burnout seems to be a much more common form of distress among medical students (12–14, 36).

Although we cannot confirm a causal relationship between burnout and suicidal ideation, several criteria for causality are satisfied (37). The association is biologically plausible and analogous to the association between suicidal ideation and depression. Burnout demonstrated a strong dose–response relationship with suicidal ideation that persisted on multivariable analysis that controlled for other factors, including symptoms of depression. The association between burnout and sui-

cidal ideation was large (2- to 3-fold increased risk) and satisfied both the temporality requirement (burnout preceded suicidal ideation) and the criteria for reversibility (risk for suicidal ideation returned to baseline with recovery from burnout). Additional studies are now needed to confirm and further explore this relationship.

Identifying risk factors for suicidal ideation provides the opportunity for interventions to prevent an adverse outcome. Of note, the trajectory for students with burnout is not an inevitable worsening of distress. In our study, 26% of students who were burned out at baseline recovered within the following year, indicating that burnout is reversible. Recovery from burnout was associated with a dramatic decrease in the likelihood of suicidal ideation, which suggests that identifying and treating burnout may provide an opportunity for medical schools to reduce suicide risk. The factors and experiences that help students recover from burnout are unknown, which indicates the need for further study. Such information could make the services provided by the student wellness programs now mandated by the Liaison Committee on Medical Education (38) more valuable.

How does the rate of suicidal ideation in our study compare with other studies? Differences among studies in how the suicidal ideation question was asked and what population was studied limit our ability to compare the rate of suicidal ideation across studies. Nonetheless, prevalence of suicidal ideation within the previous year in our study is similar to that in a national sample of 522 graduating medical students in Norway (14%) (10). In a longitudinal study of medical students at a Midwestern medical school, Clark and colleagues (6) reported that 15% to 20% of students had persistent suicidal ideation at every assessment after the first year. More recently, Givens and colleagues (7) surveyed all medical students at a private U.S. medical school and found that 6.2% of surveyed students reported contemplating suicide during their medical school training. Other small, single-institution studies have reported rates of suicidal ideation during medical school ranging from 3% to 6% (8, 9).

How should medical schools respond to our findings? First, medical schools should have a system in place to identify students who are currently suicidal. Second, schools should work to identify students at risk for future suicidal thoughts. In the longitudinal component of our study, burnout (depersonalization and personal accomplishment scores) and mental quality-of-life scores predicted suicidal thoughts over the following year. Third, schools should implement student support and wellness programs and optimize the learning environment, the organization of clinical rotations, and the diversity of clinical experiences. Schools should also be aware that negative life events, such as a serious personal illness or the death of a close family member, occur frequently among the medical student population and increase the risk for burnout (14). Although these events are outside their control, medical

schools should be aware of students experiencing such events and provide counseling support, confidential mental health services, and flexibility in curricular scheduling. Educating students about the frequency of depression and suicidal ideation and frequently making them aware of available resources seem to be sensible, worthy, and helpful (1, 39).

Our study has several limitations. First, although our response rate is typical of physician (40) and medical student (12) surveys, response bias is a possibility. The effect of professional and personal distress on response rate is unknown. One could hypothesize that distressed students may be less motivated to fill out a survey or that they would be more likely to participate because the topic is relevant to them. Regardless, even if one assumes that none of the nonresponders had suicidal ideation within the past year, the prevalence of suicidal ideation in our study would still be 249 (5.8%) of 4287 students. Second, our cross-sectional sample was slightly biased toward female and white students, as well as those outside the 25- to 30-year age range. Whether the level of distress or experience of suicidal thoughts among nonresponders differs by these demographic characteristics is unknown.

Our study has several important strengths. First, it is a large, prospective multi-institutional study. Second, students in this study attended diverse private and public medical schools geographically distributed across the U.S. and respondents were representative of medical students in the U.S. with respect to sex, relationship status, and parenting status (41, 42). The prevalence of depressive symptoms among students in this survey is similar to that in other studies of medical students (12), which suggests that the distress we observed is typical for students in the United States. Third, we used validated metrics to measure burnout, depressive symptoms, and quality of life, which allowed comparison with the general population and with other samples of medical students, residents, and physicians. Fourth, we asked about suicidal ideation by using questions from an existing inventory (15), one previously used to assess suicidal ideation among medical students (9), and the questions are similar to those assessing suicidality in large U.S. epidemiologic surveys (11, 16–18), all of which lend credence and content validity. Finally, we contained measurement error by using established instruments and multiple measures of distress (burnout, quality of life, and symptoms of depression), which allowed triangulation of results.

In summary, our results indicate a high prevalence of suicidal ideation among U.S. medical students and suggest that the increased risk for suicide among physicians may begin in medical school (1, 3). Burnout among medical students seems to be an important predictor of subsequent suicidal ideation even without symptoms of depression. Future research is needed to develop practical ways to identify students at risk and strategies to reduce student distress in the hope of improving the well-being of all students.

From the Mayo Clinic, Rochester, Minnesota; University of Alabama School of Medicine, Birmingham, Alabama; University of Minnesota Medical School, Minneapolis, Minnesota; University of Washington School of Medicine, Seattle, Washington; University of Chicago Pritzker School of Medicine, Chicago, Illinois; Uniformed Services University of the Health Sciences, Bethesda, Maryland; and University of California, San Diego, San Diego, California.

Grant Support: By an Education Innovation award from the Mayo Clinic.

Potential Financial Conflicts of Interest: None disclosed.

Requests for Single Reprints: Liselotte N. Dyrbye, MD, 200 First Street Southwest, Rochester, MN 55905.

Current author addresses are available at www.annals.org.

References

- Center C, Davis M, Detre T, Ford DE, Hansbrough W, Hendin H, et al. Confronting depression and suicide in physicians: a consensus statement. *JAMA*. 2003;289:3161-6. [PMID: 12813122]
- Schernhammer ES, Colditz GA. Suicide rates among physicians: a quantitative and gender assessment (meta-analysis). *Am J Psychiatry*. 2004;161:2295-302. [PMID: 15569903]
- Schernhammer E. Taking their own lives—the high rate of physician suicide. *N Engl J Med*. 2005;352:2473-6. [PMID: 15958803]
- Hays LR, Cheever T, Patel P. Medical student suicide, 1989-1994. *Am J Psychiatry*. 1996;153:553-5. [PMID: 8599405]
- Pepitone-Arreola-Rockwell F, Rockwell D, Core N. Fifty-two medical student suicides. *Am J Psychiatry*. 1981;138:198-201. [PMID: 7457640]
- Clark DC, Zeldow PB. Vicissitudes of depressed mood during four years of medical school. *JAMA*. 1988;260:2521-8. [PMID: 3172426]
- Givens JL, Tjia J. Depressed medical students' use of mental health services and barriers to use. *Acad Med*. 2002;77:918-21. [PMID: 12228091]
- Tjia J, Givens JL, Shea JA. Factors associated with undertreatment of medical student depression. *J Am Coll Health*. 2005;53:219-24. [PMID: 15813232]
- Dahlin M, Joneborg N, Runeson B. Stress and depression among medical students: a cross-sectional study. *Med Educ*. 2005;39:594-604. [PMID: 15910436]
- Tyssen R, Vaglum P, Grønvold NT, Ekeberg O. Suicidal ideation among medical students and young physicians: a nationwide and prospective study of prevalence and predictors. *J Affect Disord*. 2001;64:69-79. [PMID: 11292521]
- Kessler RC, Borges G, Walters EE. Prevalence of and risk factors for lifetime suicide attempts in the National Comorbidity Survey. *Arch Gen Psychiatry*. 1999;56:617-26. [PMID: 10401507]
- Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Acad Med*. 2006;81:354-73. [PMID: 16565188]
- Dyrbye LN, Thomas MR, Eacker A, Harper W, Massie FS Jr, Power DV, et al. Race, ethnicity, and medical student well-being in the United States. *Arch Intern Med*. 2007;167:2103-9. [PMID: 17954805]
- Dyrbye LN, Thomas MR, Huntington JL, Lawson KL, Novotny PJ, Sloan JA, et al. Personal life events and medical student burnout: a multicenter study. *Acad Med*. 2006;81:374-84. [PMID: 16565189]
- Meehan PJ, Lamb JA, Saltzman LE, O'Carroll PW. Attempted suicide among young adults: progress toward a meaningful estimate of prevalence. *Am J Psychiatry*. 1992;149:41-4. [PMID: 1728183]
- Cooper-Patrick L, Crum RM, Ford DE. Identifying suicidal ideation in general medical patients. *JAMA*. 1994;272:1757-62. [PMID: 7966924]
- Suicidality. In: National Comorbidity Survey, Collaborative Psychiatric Epidemiology Surveys. Accessed at www.icpsr.umich.edu/cocon/cpes/cpes/BLSUICIDALITY/all/section.xml on 15 May 2008.
- National Center for Health Statistics. Youth Risk Behavior Survey. Hyattsville, MD: U.S. Department of Health and Human Services; 2007. Accessed at www.cdc.gov/nchs/dataawh/nchsdefs/suicidalideation.htm on 15 May 2008.
- Maslach C, Jackson SE, Leiter MP. Maslach Burnout Inventory Manual. 3rd ed. Palo Alto, CA: Consulting Psychologists Pr; 1996.
- West CP, Huschka MM, Novotny PJ, Sloan JA, Kolars JC, Habermann TM, et al. Association of perceived medical errors with resident distress and empathy: a prospective longitudinal study. *JAMA*. 2006;296:1071-8. [PMID: 16954486]
- Thomas NK. Resident burnout. *JAMA*. 2004;292:2880-9. [PMID: 15598920]
- Arthur NM. The assessment of burnout: A review of three inventories useful for research and counseling. *J Couns Dev*. 1990;69:186-89.
- Söderfeldt M, Söderfeldt B, Warg LE, Ohlson CG. The factor structure of the Maslach Burnout Inventory in two Swedish human service organizations. *Scand J Psychol*. 1996;37:437-43. [PMID: 8931397]
- Toppinen-Tanner S, Ojajarvi A, Väänänen A, Kalimo R, Jäppinen P. Burnout as a predictor of medically certified sick-leave absences and their diagnosed causes. *Behav Med*. 2005;31:18-27. [PMID: 16078523]
- Shanafelt TD, Bradley KA, Wipf JE, Back AL. Burnout and self-reported patient care in an internal medicine residency program. *Ann Intern Med*. 2002;136:358-67. [PMID: 11874308]
- Guthrie E, Black D, Bagalkote H, Shaw C, Campbell M, Creed F. Psychological stress and burnout in medical students: a five-year prospective longitudinal study. *J R Soc Med*. 1998;91:237-43. [PMID: 9764076]
- Thomas MR, Dyrbye LN, Huntington JL, Lawson KL, Novotny PJ, Sloan JA, et al. How do distress and well-being relate to medical student empathy? A multicenter study. *J Gen Intern Med*. 2007;22:177-83. [PMID: 17356983]
- Dyrbye LN, Thomas MR, Huschka MM, Lawson KL, Novotny PJ, Sloan JA, et al. A multicenter study of burnout, depression, and quality of life in minority and nonminority US medical students. *Mayo Clin Proc*. 2006;81:1435-42. [PMID: 17120398]
- Spitzer RL, Williams JB, Kroenke K, Linzer M, deGruy FV 3rd, Hahn SR, et al. Utility of a new procedure for diagnosing mental disorders in primary care. The PRIME-MD 1000 study. *JAMA*. 1994;272:1749-56. [PMID: 7966923]
- 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;12:439-45. [PMID: 9229283]
- Ware JE, Kosinski M, Dewey JE, Gandek B. How to Score and Interpret Single-Item Health Status Measures: A Manual for Users of the SF-8 Health Survey. Lincoln, RI: QualityMetric Incorporated; 2001.
- Shanafelt TD, West C, Zhao X, Novotny P, Kolars J, Habermann T, et al. Relationship between increased personal well-being and enhanced empathy among internal medicine residents. *J Gen Intern Med*. 2005;20:559-64. [PMID: 16050855]
- Turner-Bowker DM, Bayliss MS, Ware JE Jr, Kosinski M. Usefulness of the SF-8 Health Survey for comparing the impact of migraine and other conditions. *Qual Life Res*. 2003;12:1003-12. [PMID: 14651418]
- Freund RJ, Littell RC. SAS System for Regression. 2nd ed. Cary, NC: SAS Institute; 2000.
- Crosby AE, Cheltenham MP, Sacks JJ. Incidence of suicidal ideation and behavior in the United States, 1994. *Suicide Life Threat Behav*. 1999;29:131-40. [PMID: 10407966]
- Dahlin ME, Runeson B. Burnout and psychiatric morbidity among medical students entering clinical training: a three year prospective questionnaire and interview-based study. *BMC Med Educ*. 2007;7:6. [PMID: 17430583]
- Fletcher RH, Fletcher SW. Chapter 11: Cause. In: *Clinical Epidemiology: The Essentials*. Philadelphia: Lippincott Williams & Wilkins; 2005.
- Liaison Committee on Medical Education. Accreditation Standards. Chicago, IL and Washington, DC: Association of American Medical Colleges and American Medical Association; 2003. Accessed at www.lcme.org/standard.htm on 16 July 2008.
- Mann JJ, Apter A, Bertolote J, Beautrais A, Currier D, Haas A, et al. Suicide prevention strategies: a systematic review. *JAMA*. 2005;294:2064-74. [PMID: 16249421]
- Kellerman SE, Herold J. Physician response to surveys. A review of the literature. *Am J Prev Med*. 2001;20:61-7. [PMID: 11137777]
- Association of American Medical Colleges. Medical School Graduation Questionnaire. Washington, DC: Assoc of American Medical Colleges; 1995. Accessed at www.aamc.org/data/gq/allschoolsreports/1995.pdf on 22 January 2007.
- Association of American Medical Colleges. FACTS—Applicants, Matriculants and Graduates. Total Enrollment by Sex and School, 2001–2005. Washington, DC: Assoc of American Medical Colleges; 2005. Accessed at www.aamc.org/data/facts/2005/factsenrl.htm on 17 December 2007.

Current Author Addresses: Drs. Dyrbye, Thomas, Sloan, and Shadafelt; Mr. Szydlo; and Mr. Novotny: 200 First Street Southwest, Rochester, MN 55905.

Dr. Massie: 1530 Third Avenue South, FOT 720, Birmingham, AL 35294.

Dr. Power: University of Minnesota, 516 Delaware Street Southeast, Minneapolis, MN 55455.

Dr. Eacker: General Internal Medicine Center, 4245 Roosevelt Way Northeast, Seattle, WA 98105.

Dr. Harper: 5841 South Maryland Avenue, MC 3051, Chicago, IL 60637.

Dr. Durning: 4301 Jones Bridge Road, Bethesda, MD 20814-4799.

Dr. Moutier: University of California, San Diego School of Medicine, Medical Teaching Facility Room 180, 9500 Gilman Drive, 0606, La Jolla, CA 92093-0606.