

PAPER

General

Secondary traumatic stress, burnout, compassion satisfaction, and perceived organizational trauma readiness in forensic science professionals

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Abstract

Secondary traumatic stress, burnout, and compassion satisfaction have been described since the 1980s and extensively studied in first responders, law enforcement, legal professionals, and human service providers. There are few studies in forensic science professionals. To determine levels of secondary traumatic stress, burnout, and compassion satisfaction and relate these to demographics and job characteristics, we administered online a modified version of the Professional Quality of Life (ProQOL) questionnaire to professionals in crime laboratories and medical examiner offices. Participants also completed a modified version of the Vicarious Trauma-Organizational Readiness Guide (VT-ORG) to measure perceptions of their organizations' efforts to address vicarious trauma and promote health and wellness. Results from 419 subjects indicated that field-based forensic science professionals registered higher levels of secondary traumatic stress compared to laboratory-based professionals, but burnout and compassion satisfaction were not significantly different between these groups. Demographic variables did not predict any of these outcome measures, but work with victims' families and testifying significantly, albeit weakly, predicted higher secondary traumatic stress. Greater employee belief that their organizations were addressing issues of stress and trauma predicted lower levels of secondary traumatic stress and burnout and higher levels of compassion satisfaction. Write-in responses by participants paralleled the quantitative findings. These results indicate a need to strengthen organizational efforts to address stress and trauma and promote health and wellness, particularly in professionals with direct field-based exposure to crime scenes, contact with victims' families, and responsibility for testifying.

KEYWORDS

crime laboratories, medical examiners, ProQOL, secondary traumatic stress, trauma readiness, vicarious trauma, VT-ORG

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Highlights

- Research on secondary traumatic stress, burnout, and compassion satisfaction is limited in forensic professionals.
- Greater stress experienced by field-based professionals may result from the impact of direct exposures.
- Employees report lower stress and burnout when they perceive their organization promotes awareness and wellness.
- Efforts to address stress varied across the seven organizations studied.
- Greater attention to these issues is needed to increase resiliency in forensic professionals.

1 | INTRODUCTION

The phenomena of "secondary traumatic stress" and "compassion fatigue" [1], and the related construct "vicarious traumatization" [2], have been described since the mid-1980s, roughly coinciding with the growth in mental health treatments focused on clients who are victims of trauma. These terms vary in emphasis, but all describe responses to exposure to challenging traumatic material from a client or on the job. Secondary traumatic stress describes responses that include intrusive thoughts, avoidance and withdrawal, and symptoms of tension and disturbed sleep [1], responses similar to those delineated in the diagnosis of post-traumatic stress disorder (PTSD) [3]. The definition of vicarious trauma includes these responses as well as alterations in basic assumptions about the self, people, society, and personal safety [2]. The term compassion fatigue, initially designating a state of exhaustion the professional suffers from the negative impact of trauma experienced by clients rendering the professional no longer able to provide help clients [1], was later recast as a combination of secondary traumatic stress and "burnout" [4].

Burnout [5] develops gradually due to the accumulation of stress such as the challenging nature of intensive contact with clients, work overload, and stressful work conditions. Symptoms of burnout include exhaustion, feelings of cynicism and detachment from the job, and a sense of ineffectiveness and lack of accomplishment. Risk factors for developing burnout include female gender, overwork, the slow and erratic pace of the work, lack of success, and the tendency of the work to raise personal issues [5]. The burnout formulation overlaps with the constructs of depression and job satisfaction [5,6]. Professionals suffering from secondary traumatic stress and/or burnout report lower job satisfaction, emotional exhaustion, increased thoughts of leaving their position, and stress in their family lives [7].

In contrast to these negative responses to work with clients and work overload, the construct "compassion satisfaction" designates a sense of reward, efficacy, and competence derived from work as a helping professional [4,8].

A large literature has documented secondary traumatic stress in a range of professionals including first responders [9,10], law enforcement [11-14], human service professionals [15,16], and public defenders [17]. Risk factors identified in these studies for the

development of secondary traumatic stress include intensity of exposure, graphic nature of the material, cases involving child victims, identification by the professional with the victim, gender, personal history of trauma, prior symptoms, organizational factors, and social supports [1,14,18], although the strength and consistency of these associations has been variable [19]. Further, individuals suffering from symptoms of secondary traumatic stress are more likely to overestimate risk and demonstrate impaired performance on complex cognitive and memory tasks when confronted with acute stress [20].

In the last decade, there has been increased interest in the impact of stress and exposure to traumatic material on forensic science professionals. These professionals encompass a wide range of specialties including crime and death scene investigation (field-based work), and laboratory analysis of crime scene-related materials (e.g., chemicals, drugs, DNA), analysis of digital and multimedia evidence, and postmortem examinations performed by medical examiners and coroners (laboratory-based work). The 2009 Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council Report [21] described a range of challenges among the forensic sciences including lack of clear standards and research needs, large backlogs, and inconsistent certification and accreditation systems. A recent NIJ report to Congress on the Needs Assessment of Forensic Laboratories and Medical Examiner/Coroner Offices indicated that personnel need resources to address workforce stress and vicarious trauma associated with the various forensic science work environments and that forensic agencies and management can implement strategies that support operational readiness, organizational health, and workforce resiliency [22]. Additional observations by forensic science professionals themselves [23,24] identified stressors including exposure to traumatic scenes, evidence, and other case material, expectations for perfection (or "zero tolerance" for errors), and work within an adversarial legal system requiring testimony.

Quantitative studies involving surveys of small groups of forensic science professionals have documented depression, poor sleep, and changes in worldview in Romanian forensic pathologists [25], elevated scores on a measure of psychological symptoms in child homicide investigators [26], and a correlation between post-traumatic symptoms and homicide experience, fatigue, and years in the field in Korean forensic science investigators [27]. Other findings include

increased heart rates in crime scene investigators attending crime scenes [28], PTSD symptoms in Slovenian crime scene technicians [29], and higher levels of stress triggered by trauma-related work exposure, particularly when the exposure reminded the worker of a loved one [30].

A recent survey of crime scene investigators utilizing a PTSD measure found symptoms suggestive of a clinical disorder in 9.3% of 225 crime scene investigators [31]. In the largest study to date, funded through the National Institute of Justice's Social Science Research on Forensic Science program, Holt, Blevins, Foran, & Smith [32] surveyed 899 forensic science professionals and found a 10–20% rate of difficulty falling asleep, irritability, difficulty concentrating, a constant state of alertness, easy startle, nightmares, detachment and emotional numbness, feelings of mistrust and betrayal, and physical aches and pains with no apparent cause. All of these symptoms overlap with secondary traumatic stress.

In addition to broad surveys of forensic science professionals, studies have also investigated specific disciplines. For example, studies of professionals investigating digital crimes have identified increased risk for secondary traumatic stress related to length of time working with pornographic materials [33] and work with materials depicting children [34,35]. Despite reporting high stress, digital forensic professionals reported high job satisfaction [36]. Another study comparing digital forensic examiners, investigators (who interact with victims, families, and offenders), and professionals playing both roles in child pornography investigations revealed more secondary traumatic stress symptoms, more feelings of worthlessness, and lower concentration in the dual group compared to digital examiners, with investigators also higher on psychological distress and lower on concentration compared with digital forensic investigators [37]. These findings support previous literature which suggest that face-to-face interactions are a more potent source for secondary traumatic symptoms and psychological distress, and are consistent with the findings in crime scene investigators. A study of 395 workers in medical examiner and coroner offices found 12.8% met criteria for likely diagnostic levels of PTSD, 21.0% scored at or above the mild level of depression, and nearly 30% had clinically significant levels of anxiety [38]. Death investigators and administrators demonstrated more symptoms of PTSD and depression than medical examiners. Infant and child-related deaths were the strongest predictors of symptoms. Similarly, a recent study of professionals predominantly in medical examiner offices by Goldstein and Alesbury [39] found significant correlations between burnout and indirect contact with remains and next of kin, as well as weak but significant correlations between burnout and years of experience, and between stress levels and mass fatality experience.

Given that secondary traumatic stress and burnout predict lower job satisfaction, less productivity, and higher turnover over [5,40], research has attempted to identify organizational factors that may mitigate these responses. Rogers [41] highlighted the documented effectiveness of education, resilience workshops, problem-solving and sharing, mentoring, mindfulness, and relaxation techniques in lowering secondary traumatic stress in health professionals. Organizations that are sensitive to

the needs of trauma clients and the impact on employees of contact with trauma material have been labeled “trauma-informed” [42,43]. Trauma-informed workplaces promote improved function, decreased symptoms, and greater satisfaction among employees [40,42].

Studies in forensic science professionals have identified the positive effects of individual coping strategies including social support, humor, avoidance/distraction, and disengagement in coping with secondary traumatic stress [32,33,44]. In the study comparing digital forensic examiners, investigators, and dual role professionals in child pornography, individuals in the dual role were less likely to cope by working harder, less likely to withdraw, and more likely to use shopping (a potentially negative coping mechanism) as a distraction compared to digital forensic examiners. The dual group also demonstrated a trend to greater use of sedatives [37]. In terms of organizational interventions, Holt et al. [32] recommended increased management attention to work hours, scheduling, role-conflict, and communication between management and forensic science professionals, although these recommendations were not directed specifically at secondary traumatic stress but rather at overall functioning. There is little information about the availability of resources to address secondary traumatic stress, burnout, and wellness in forensic organizations, but at least one study found that most professionals surveyed did not feel they had a professional community in which they could freely discuss wellness concerns [39].

1.1 | Current study

To date, few studies have quantified secondary traumatic stress, burnout, and compassion satisfaction in forensic science professionals. Further, no studies have systematically addressed the relationship between organizational attention to trauma and these responses in forensic science professionals. To address these issues, we administered an online survey to better characterize secondary traumatic stress, burnout, and compassion satisfaction in forensic science professionals working in crime laboratories and medical examiner offices. We also measured professionals' perceptions of their organization's efforts to mitigate stress and address trauma as well as the relationship of these perceptions to secondary traumatic stress, burnout, and compassion satisfaction. Because available research indicates that greater exposure to crime scenes and face-to-face interaction predicts more symptoms [37–39], we predicted that professionals who identified themselves as predominantly field-based (attending crime scenes and interacting with victims and families) would score higher on measures of secondary traumatic stress and burnout and lower on compassion satisfaction compared with laboratory-based professionals (who do not go into the field) and managers.

Specific questions for the study included the following:

1. Are there differences in secondary traumatic stress, burnout, and compassion satisfaction between field-based scientists, laboratory-based scientists, and their managers?

2. What demographic and job characteristics predict secondary traumatic stress, burnout, and compassion satisfaction?
3. Are there differences between field-based scientists, laboratory-based scientists, and managers in their perceptions of their facility's efforts to address secondary traumatic stress and wellness?
4. Do employee perceptions of their facility's efforts to address these issues correlate with secondary traumatic stress, burnout, and compassion satisfaction?

2 | METHODS

2.1 | Participants

The questionnaire was solicited to approximately 1,690 individuals from seven crime laboratories and medical examiner offices in the United States in the summer/fall of 2019. The American Society of Crime Laboratory Directors (ASCLD) Trauma and Stress work group assisted with outreach to identify facilities that were interested in participating. The response rate was 34% with 574 respondents participating in the assessment. Fifty-five respondents were excluded from the final data set: six who did not consent to the questionnaires, 35 who did not complete most of the demographic portion of the questionnaires, and 14 who identified as administration or clerical only and not forensic science professionals. The final sample size for demographics included 519 participants. As shown in Table 1, the majority of participants were female ($N = 366$; 70.5%), white ($N = 372$; 70.1%), and married/common law ($N = 278$; 53.6%). 238 (45.9%) held a master's degree, and 112 (21.6%) were 25–30 years old.

Participants were asked to identify the role in their current position. Respondents could only select one response and the choices included field-based (crime scene investigators and other scientists who predominately gather evidence at the scene), laboratory-based (those who predominately analyze materials but do not go to the crime scene), managers/supervisors (have supervisory responsibility), or clerical staff. Excluding clerical staff and those who identified themselves as administrators, among the forensic science professionals, fifty-two individuals identified as field-based scientists (10.1%), 351 as laboratory-based scientists (67.6%), and 116 as managers or supervisors (22.3%). As shown in Table 2, the majority of participants did not work with victims ($n = 425$; 81.9%), victim families ($n = 459$; 88.4%), or victim services ($n = 487$; 93.8%). Additionally, the majority of participants did not testify ($n = 286$; 55.1%), were unsworn ($n = 434$; 82.6%), and worked overtime ($n = 326$; 62.8%). Participants were also asked to identify their primary activities (e.g., DNA, controlled substance, digital/multimedia evidence) during the last two years. Participants were able to select multiple areas. As shown in Table 3, the most common activities were DNA ($n = 149$) and administrative ($n = 95$). An additional 89 participants were removed for missing responses on the two survey instruments. The sample size for statistical analysis for the research questions of the current study was 419.

2.2 | Measurement

The online, anonymous questionnaire included four sections: demographics, job responsibilities, the Vicarious Trauma- Organizational Readiness Guide (VT-ORG) [45], and the Professional Quality of Life (ProQOL) [4]. The job responsibilities section queried specific job discipline, time spent testifying, sworn vs. unsworn status, hours worked per week and overtime, and work with victims, victims' families, and victims' services.

The VT-ORG [45] was developed by Office for Victims of Crime, Department of Justice, Office of Justice Programs in collaboration with at Northeastern University to assist organizations in evaluating their efforts to address trauma for first responders including emergency medical services, fire fighters, services, and victim services. The instrument includes five subscales: Leadership and Mission, Management and Supervision, Employee Empowerment and Work Environment, Training and Professional Development, and Staff Health and Wellness. Questions ask the employee to rate their perceptions of their organization's communication around and promotion of activities during the last six months in each of the five VT-ORG subscale areas using a 1 = "never" to 5 = "always" Likert scale. For example, "My managers are readily accessible to support staff members following a critical or acute incident" from the Management and Supervision section, or "Differentiation between work and non-work hours is recognized and respected" in the Staff Health and Wellness section. The VT-ORG was modified in the current assessment to include vocabulary relevant to forensic scientists (e.g., "My facility" versus "The department"). The unvalidated modified VT-ORG can be found in the Appendix S1. Cronbach's alpha for each of the subscales in the current sample was Leadership and Mission ($\alpha = 0.85$); Management and Supervision ($\alpha = 0.89$); Employee Empowerment and Work Environment ($\alpha = 0.89$); Training and Professional Development ($\alpha = 0.79$); and Staff Health and Wellness ($\alpha = 0.85$).

The ProQOL was developed as a self-report instrument for helping professionals to measure levels of secondary traumatic stress, burnout, and compassion satisfaction [4]. The 30 questions ask participants to rate their experiences on a 1= "never" to 5= "very often" scale over the prior 30 days. For example, "I feel as though I am experiencing the trauma of someone I have helped" in the secondary traumatic stress section, "I feel worn out because of my work as a helper" in the burnout section, and "I am pleased with how I am able to keep up with new techniques and protocols" in the compassion satisfaction section. The ProQOL authors indicate that the instrument can be modified to match the group under study. In the current study, the ProQOL was modified (See Appendix S1) to include vocabulary relevant to forensic scientists (e.g., substituting "cases" for "someone I have helped"). Cronbach's alpha in the current study for the subscales was secondary traumatic stress ($\alpha = 0.84$); burnout ($\alpha = 0.80$); and compassion satisfaction ($\alpha = 0.92$). Subscales for both the VT-ORG and the ProQOL met the reliability threshold of 0.7 as described by Kline [46]. Further, Cronbach's alphas for the current study were similar to previous research which used the VT-ORG [45] and the ProQOL [4].



TABLE 1 Demographics

	Laboratory-based N = 351 (%)	Field-based N = 52 (%)	Manager N = 116 (%)	Total N = 519 (%)
Age				
18-24	17 (4.8)	2 (3.8)	0 (0)	19 (3.7)
25-30	99 (28.2)	10 (19.2)	3 (2.6)	112 (21.6)
31-35	76 (21.7)	10 (19.2)	12 (10.3)	98 (18.9)
36-40	55 (15.7)	5 (9.6)	33 (28.4)	93 (17.9)
41-45	40 (11.4)	9 (17.3)	23 (19.8)	72 (13.9)
46-50	22 (6.3)	12 (23.1)	15 (12.9)	49 (9.4)
51-55	19 (5.4)	1 (1.9)	16 (13.8)	36 (6.9)
56 or older	23 (6.3)	3 (5.8)	14 (12.1)	40 (7.7)
Gender				
Female	260 (74.1)	30 (57.7)	76 (65.5)	366 (70.5)
Male	84 (23.9)	22 (42.3)	40 (34.5)	146 (28.1)
Other	1 (0.3)	0 (0)	0 (0)	1 (0.2)
Prefer not to respond	6 (1.7)	0 (0)	0 (0)	6 (1.2)
Race				
AI or AN	3 (0.9)	0 (0)	0 (0)	3 (0.6)
Asian	23 (6.6)	2 (3.8)	4 (3.4)	29 (5.6)
Bi-racial	7 (2.0)	1 (1.9)	2 (1.7)	10 (1.9)
Black or AA	27 (7.7)	17 (32.7)	10 (8.6)	54 (10.4)
Hispanic	24 (6.9)	4 (7.7)	8 (6.9)	36 (6.9)
NH or PI	1 (0.3)	0 (0)	0 (0)	1 (0.2)
White	251 (71.7)	26 (50.0)	86 (74.1)	372 (70.1)
Other	1 (0.3)	1 (1.9)	0 (0)	2 (0.4)
Prefer not to respond	13 (3.7)	1 (1.9)	6 (5.2)	20 (3.9)
Missing	1	0	0	0
Marital status				
Divorced/separated	17 (4.8)	7 (13.5)	9 (7.8)	33 (6.4)
Married/common law	181 (51.6)	20 (38.5)	7 (6.4)	278 (53.6)
Single/never married	149 (42.5)	25 (48.1)	30 (25.9)	204 (39.3)
Widowed	4 (1.1)	0 (0)	0 (0)	4 (0.8)
Education				
HS graduate or GED	3 (0.9)	0 (0)	1 (0.9)	4 (0.8)
Some college	6 (1.7)	7 (13.5)	5 (4.3)	18 (3.5)
Associate or 2-year degree	2 (0.6)	6 (11.5)	0 (0)	8 (1.5)
Bachelor's degree	134 (38.2)	9 (17.3)	21 (18.1)	164 (31.6)
Some graduate	30 (8.5)	8 (15.4)	13 (11.2)	51 (9.8)
Master's degree	158 (45.0)	18 (34.6)	62 (53.4)	238 (45.9)
MD	6 (1.7)	1 (1.9)	3 (2.6)	10 (1.9)
PhD	11 (3.1)	2 (3.8)	9 (7.8)	22 (4.2)
Other	1 (0.3)	1 (1.9)	2 (1.7)	4 (0.8)

Abbreviations: AA, African American; AI, American Indiana; AN, Alaska Native; NI, Native Hawaiian; PI, Pacific Islander.

The questionnaires ended with write-in questions enabling participants to provide additional information or comments regarding the questionnaire topic, consistent with intra-method mixing, that is, quantitative survey with open-ended questions [47].

2.3 | Procedures

During the project development phase, researchers conducted onsite visits at each of the seven facilities that volunteered to participate,

TABLE 2 Job responsibilities

	Laboratory-based N = 351(%)	Field-based N = 52(%)	Manager N = 116(%)	Total N = 519(%)
Testifying				
None	178 (50.7)	37 (71.2)	71 (61.2)	286 (55.1)
1-5	129 (26.8)	10 (19.2)	39 (33.6)	178 (34.3)
6-10	29 (8.3)	2 (3.8)	6 (5.2)	37 (7.1)
11-15	9 (2.6)	2 (3.8)	0 (0)	11 (2.1)
16-20	3 (0.9)	0 (0)	0 (0)	3 (0.6)
21-25	1 (0.3)	0 (0)	0 (0)	1 (0.2)
26-30	1 (0.3)	0 (0)	0 (0)	1 (0.2)
31-35	0 (0)	0 (0)	0 (0)	0 (0)
36-40	0 (0)	1 (1.9)	0 (0)	1 (0.2)
More than 40	1 (0.3)	0 (0)	0 (0)	1 (0.2)
Status				
Sworn	58 (16.5)	11 (21.2)	14 (12.1)	83 (15.9)
Unsworn	291 (82.9)	41 (78.8)	102 (87.9)	434 (82.6)
Missing	2 (0.6)	0 (0)	0 (0)	2 (0.5)
Over time				
None	135 (38.5)	10 (19.2)	48 (41.4)	193 (37.2)
1-5 h	156 (44.4)	24 (46.2)	38 (32.8)	218 (42)
6-10 h	50 (14.2)	9 (17.3)	26 (22.4)	85 (16.4)
11-15 h	8 (2.3)	4 (7.7)	3 (2.6)	15 (2.9)
<15 h	2 (0.6)	5 (9.6)	1 (0.9)	8 (1.5)
Victims				
Yes	27 (7.7)	42 (80.8)	25 (21.6)	94 (18.1)
No	324 (92.3)	10 (19.2)	91 (78.4)	425 (81.9)
Victims' families				
Yes	11 (3.1)	30 (57.7)	19 (16.4)	60 (11.6)
No	340 (96.9)	22 (42.3)	97 (83.6)	459 (88.4)
Victim services				
Yes	7 (2.0)	15 (28.8)	10 (8.6)	32 (6.2)
No	344 (98.0)	37 (71.2)	106 (91.4)	487 (93.8)

meeting with administration to promote participation and refine demographic and job responsibility language in the questionnaires. During these meetings, it also emerged that there was a range of efforts by the seven organization to address stress in employees. As an incentive for participation, we offered follow-up meetings to each interested facility to present overall findings as well as site-specific aggregate results to aid in development of strategies to address secondary traumatic stress, burnout, and compassion satisfaction.

Potential participants received a series of emails notifying them of the study, directing them to Qualtrics, and reminding them to participate. The materials contained a consent form indicating participation was voluntary and anonymous. Questionnaires were left open for a period of four to six weeks (this varied between facilities due to vacation periods). The study was approved by the Department of Justice Office of Justice Programs Institutional Review Board

(IRB), and all respondents were treated in accordance with the ethical standards set forth by the American Psychological Association. Per the IRB, all follow-up presentations were completed with strict employee anonymity and only group statistics were offered.

2.4 | Analysis plan

The data were downloaded from the survey platform and uploaded to the statistical package, IBM SPSS version 25. In accordance with Cramer and Bock [48], a multivariate analysis of variance (MANOVA) was performed to help protect against inflating the type 1 error rate in the follow-up post hoc comparisons. However, prior to conducting the MANOVA, a series of Pearson correlations were performed between all of the dependent variables (VT-ORG

TABLE 3 Discipline by job category

	Laboratory-based	Field-based	Manager	Total
Anthropology	2	2	2	6
Autopsy Technician	1	6	5	12
DNA	106	4	39	149
Blood Pattern Analysis	0	3	0	3
Case Manager	25	4	28	57
Crime/Death Science Investigator	11	24	17	52
Controlled Substance	51	5	10	66
Decedent Identification	11	7	7	25
Digital/Multimedia Evidence	12	6	5	23
Evidence Technician	26	7	7	40
Explosives	5	2	3	10
Fatality Team	5	4	3	12
Firearms	23	1	5	29
Fire debris/Arson Analysis	4	2	5	11
Hazardous Materials	10	8	7	25
Histologists	0	2	0	2
Impression Evidence	9	2	2	13
Intelligence Analysts	1	3	2	6
Administration	40	5	50	95
Latent Print Analysis	31	1	4	36
Medicolegal Death Investigator	2	8	5	15
Pathology/Autopsy	3	4	6	13
Photographer	16	14	5	35
Quality Assurance	31	3	12	46
Questioned Documents	9	2	3	14
Tool Marks	9	1	4	14
Trace Evidence	25	2	5	32
Toxicology	18	2	4	24

and ProQOL subscales) in order to test the MANOVA assumption that the dependent variables would be correlated with each other in the moderate range (i.e., 0.20–0.60). [49] As shown in Table 6, a meaningful pattern of correlations was observed among most of the dependent variables, suggesting the appropriateness of a MANOVA.

TABLE 4 Means (SD) on professional quality of life (ProQOL) by job category

ProQOL	Job Role		
	Laboratory-based	Field-based	Manager
Secondary traumatic stress	49.01 (9.53)	54.09 (11.26)*	51.06 (10.48)
Burnout	49.82 (9.64)	50.43 (12.22)	50.36 (9.47)
Compassion satisfaction	50.12 (9.63)	50.42 (10.34)	49.91 (10.46)

* $p = .007$ (field vs. laboratory).

A MANOVA was then conducted to determine differences between field-based scientists, laboratory-based scientists, and managers' scores on the three ProQOL subscales and five VT-ORG subscales. To measure the relationship between the ProQOL and the VT-ORG, a two-tail, zero-order correlation was conducted. Additionally, three multiple regressions examined the contributions of demographic and job responsibility variables in predicting secondary traumatic stress, burnout, and compassion satisfaction. Following Creswell and Plano Clark [50], the write-in response question was analyzed separately and used to help further explain or validate the quantitative findings. These responses are presented in the Discussion section.

3 | RESULTS

A one-way MANOVA was conducted to compare field-based scientists and laboratory-based scientists scores on the ProQOL subscales as shown in Table 4. There was a statistically significant difference in secondary traumatic stress between field-based versus laboratory-based scientists, $F(3, 311) = .384$, $p = 0.01$; Wilk's $\Lambda = 0.96$, partial $\eta^2 = 0.04$. Results revealed that field-based scientists reported significantly more ($M = 54.09$) secondary traumatic stress than laboratory-based scientists ($M = 49.01$), $F(1, 315) = 9.34$, $p = 0.002$; $\eta^2 = 0.03$. There were no significant differences in burnout ($M = 50.43$ vs. 49.82) or compassion satisfaction ($M = 50.42$ vs. 50.12) between field- and laboratory-based scientists.

In a post hoc analysis, the Tukey–Kramer test to account for the unequal sample sizes was performed to examine individual mean difference comparisons across the two groups of scientists [51]. Results revealed that the post hoc mean comparison for the mean score of secondary traumatic stress between field-based versus laboratory-based scientists was statistically significant ($p = 0.007$).

A one-way MANOVA was also conducted to compare the mean differences between laboratory-based scientist's and manager/supervisor scores on the ProQOL subscales. There were no statistically significant differences in secondary traumatic stress ($M = 49.01$ vs. 51.06), burnout ($M = 49.82$ vs. 50.36), or compassion satisfaction ($M = 50.12$ vs. 49.91), between laboratory-based scientists versus managers/supervisors, $F(3, 366) = 1.13$, $p = 0.34$; Wilk's $\Lambda = 0.99$, partial $\eta^2 = 0.009$ (see Table 4).

A one-way MANOVA was conducted to compare the mean differences between field-based scientists and laboratory-based scientists' scores on the VT-ORG subscales in Table 5. There was no statistically significant difference in the belief that the facility is adequately addressing vicarious trauma between field-based versus laboratory-based scientists $F(5, 301) = 2.15, p = 0.06$; Wilk's $\Lambda = 0.96$, partial $\eta^2 = 0.03$ (see Table 5).

A one-way MANOVA was also conducted to compare the mean differences between laboratory-based scientists' and manager/supervisor scores on the VT-ORG subtests. Results from the MANOVA found a statistically significant difference in the belief that the facility is adequately addressing vicarious trauma between laboratory-based scientist's versus managers/supervisors $F(5, 354) = 4.19, p = 0.001$; Wilk's $\Lambda = 0.94$, partial $\eta^2 = 0.05$. A post hoc analysis was performed to examine individual mean difference comparisons across all five subtests of the VT-ORG. Although the MANOVA was significant, results of the post hoc analysis were insignificant ($p = 0.16-0.94$) across all five subtests due to unequal sample sizes (see Table 5).

Three multiple regressions were conducted to test whether gender, race, education, overtime, sworn/unsworn, testifying, and work with victims, victim families, and victim services predicted outcomes on the ProQOL. Predictor variables were re-coded prior to running the multiple regression as follows: gender (female, other), race (white, other), education (higher education degree, other), overtime (yes, no), testifying (yes, no), and sworn (sworn/unsworn). The

additional variables of work with victims, victim services, and victim families did not require recoding because they were already dichotomous (yes/no). As suggested by the analysis of variance (ANOVA), the model significantly predicted 6.3% of the variance of secondary traumatic stress, $F(1,387) = 3.24, p = 0.001$. Only two variables significantly predicted secondary traumatic stress: testifying ($t = -1.98, p = 0.05$) and working with victim families ($t = -2.12, p = 0.04$). As suggested by the ANOVA, the models did not significantly predict burnout or compassion satisfaction.

As shown in Table 6, there was a statistically significant, medium negative relationship between secondary traumatic stress and the five subscales of the VT-ORG with a range of $r = 0.26-0.38, p < 0.01$, a strong, negative relationships between burnout and the VT-ORG subscales (range $r = 0.50-0.58, p < 0.01$), and a significant large, positive relationship between compassion satisfaction and VT-ORG subscales ($r = 0.40-0.50; p < .01$).

4 | DISCUSSION

In a survey of forensic science professionals working in crime laboratories and medical examiner offices, the current study assessed levels of secondary traumatic stress, burnout, and compassion satisfaction as well as measuring employee perceptions of their organization's efforts to mitigate stress and address the impact of trauma. The participants represented multiple forensic disciplines similar to

VT-ORG	Job role		
	Laboratory-based	Field-based	Manager
Leadership and Mission	3.44 (0.93)	3.44 (0.98)	3.41 (0.84)
Management and Supervision	3.24 (0.92)	3.08 (0.99)	3.10 (0.82)
Employee Empowerment and Work Environment	3.16 (0.79)	3.18 (0.98)	3.17 (0.79)
Training and Professional Development	3.26 (0.79)	3.40 (0.92)	3.42 (0.65)
Staff Health and Wellness	3.10 (0.91)	3.26 (1.08)	2.98 (0.88)

No significant differences between groups.

TABLE 5 Means (SD) on vicarious trauma-organizational readiness guide (VT-ORG) by job category

VT-ORG	ProQOL		
	Secondary traumatic stress	Burnout	Compassion satisfaction
Leadership and Mission	-0.33	-0.50	0.40
Management and Supervision	-0.38	-0.52	0.43
Employee Empowerment and Work Environment	-0.31	-0.57	0.51
Training and Professional Development	-0.26	-0.58	0.51
Staff Health and Wellness	-0.31	-0.51	0.43

Note: All values significant at $p < 0.01$; two-tailed; listwise $N = 394$.

TABLE 6 Correlation: vicarious trauma-organizational readiness guide (VT-ORG) vs. professional quality of life (ProQOL)



the range of FSP disciplines described by Holt et al.,[32] except that the current study also included professionals in medical examiner offices. For the latter professionals, field-based work included both crime scenes and other death investigation scenes.

In the current study, forensic science professionals working in both the laboratory and the field as well as managers reported moderate levels of secondary traumatic stress corresponding to the designation of "sometimes" on the ProQOL, reinforcing other findings of distress in forensic professionals [32]. In addition, ProQOL secondary traumatic stress scores for all three groups were higher than in samples of police officers working with victims of sexual assault [14], emergency medical services, law enforcement, and victim services workers [40]. This suggests that forensic science professionals experience levels of stress at least comparable to those experienced by law enforcement, emergency medical services, and victims' service professionals. Future studies should focus on elucidating how these groups are similar and different in their exposure to stress and in their coping responses.

Within the current sample, field-based scientists emerged with higher secondary traumatic stress scores compared to laboratory-based scientists. This finding is congruent with existing literature indicating elevated levels of stress and secondary trauma in crime scene investigators [28,31] as well as in investigators of child pornography compared with digital only investigators [37]. In the written responses, participants explained that field exposure resulted in loss of sleep, anxiety, intrusive thoughts, and trouble forgetting horrendous aspects of the crimes, similar to responses by subjects in Holt et al.[32] Individuals not working directly with victims (e.g., laboratory-based scientists) reported they felt incapable of doing work with victims and predicted this work would be highly stressful for them. Although these correlations and participant write-in responses point toward the impact of traumatic crime scenes and encounters with victims and families as the source of increased secondary traumatic stress in field-based professionals, other elements of field-based work including the extended hours required, disruption of normal work routines, and inherent dangers on the scene (e.g., toxic materials) are likely contributors to stress in these professionals. In fact, managers at one of the facilities we visited indicated that being called to crime scenes resulted in significant stress created by delays in completing other work and by separation from family. Future research could explore these contributions to stress in forensic professionals.

Prior studies have found specific types of field-based exposures predict greater secondary traumatic stress such as homicides [30] or work involving child victims [26]. To our knowledge, no studies have identified the types of exposures in the laboratory that may increase risk for secondary traumatic stress. Although the current study did not aim to address this question, participants indicated in the written response section that work in the laboratory with crime narratives, victims, or evidence personalizing the crime (e.g., clothing) was the most stressful. More study is needed to better characterize which stressors increase the risk for secondary traumatic stress for forensic scientists in their specific roles in the field, laboratory, and as managers.

Mean levels of burnout in the current sample were similar for field-based, laboratory-based, and managers/supervisors, with all groups reporting "somewhat" amounts of burnout, as measured by questions such as, "I feel worn out because of my cases." This finding indicates that forensic science professionals experience burnout regardless of work responsibilities. Further, in the write-in responses, individuals reported stress related to excessive workload, quick turn-around times, and the pressure associated with frequent testifying. Both quantitative and qualitative findings in the current study are consistent with prior studies which identified multiple stressors facing forensic scientists including high caseloads and pressures to produce error free work [21–23,32].

The current study also found moderate compassion satisfaction across all study participants, similar to reports of moderate to high job satisfaction in other surveys [32,36]. Write-in responses revealed respondents believed their work was important, rewarding, and helped the victims, victim's families, and overall community. Future research should seek to delineate specific factors for forensic science professionals which increase job satisfaction.

The current study did not find that gender, overtime, or sworn vs. unsworn status significantly predicted any of the outcomes on the ProQOL, in contrast to other research which identified female gender and overtime as significant predictors of stress in forensic science professionals [32] and for burnout in general [5]. This finding may have derived from the unequal sample sizes in the current study (i.e., women (70.5%) unsworn (82.6%)) and a low percentage of professionals reporting more than 5 hours of overtime (21.7%). Work with victims and their families as well as testifying did emerge as predictors of secondary traumatic stress in the current study, albeit with small effects. More research is needed to distinguish which job activities are the most stressful and warrant devotion of scarce resources to reduce secondary traumatic stress.

A key finding of the current study was the strong relationship between forensic scientists' perceptions of their organization's efforts to address stress and promote well-being, and their levels of secondary traumatic stress, burnout, and compassion satisfaction. Greater employee belief that their organizations were addressing these issues predicted lower levels of secondary traumatic stress and burnout and higher levels of compassion satisfaction. Although other studies have linked organizational support to reduced levels of secondary traumatic stress and burnout [42], the current study is believed to be the first to systematically assess this relationship in forensic science professionals.

The moderate to strong correlations between the scales are also consistent with the report by the creators of the VT-ORG demonstrating its convergent validity with the ProQOL [35]. With this relationship in mind, Hallinan et al [40] recommended that "...organizations can use the VT-ORG to justify improving their response to [secondary traumatic stress] by highlighting the areas where they scored low as those that need improvement" (p. 10). To help law enforcement, emergency medical services, fire services, and victim services become trauma-informed organizations, the Office for Victims of Crime developed the "Vicarious Trauma Toolkit" [45] to

mitigate the potentially negative effects of trauma exposure. This toolkit includes the Vicarious Trauma- Organizational Readiness Guides (VT-ORG) and a “blueprint” on how to use the VT-ORG to help organizations assess their current capacity to address employees’ work-related exposure to trauma, prioritize organizational needs, and develop an action plan. Forensic science agencies in partnership with behavioral researchers can benefit from continued validation and leveraging these tools developed for criminal justice system stakeholders.

With these considerations in mind, in the follow-up meetings with each organization we shared participant VT-ORG scores on the specific scales (Leadership & Mission, Management and Supervision, Employee Empowerment, etc.) to delineate areas of relative strengths and weaknesses. The scores proved to be consistent with management descriptions of the scope of their trauma readiness interventions, particularly in the area of Staff Health and Wellness. In written responses, some employees indicated their belief that management was not providing supports which were actually available to them. This observation may reflect poor internal marketing. Management was receptive to addressing areas of relative weakness such as increasing opportunities for stress-reducing programs such as yoga, peer support, and exercise, as well as better promoting existing services (e.g., Health and Wellness programming) to employees.

In addition to the positive impact of individual strategies such as mindfulness, relaxation, and reflection [23,41], organizational strategies such as flexible scheduling, improved communication with supervisors, and education to assist employees in recognizing and mitigating stress have been identified as important interventions [32]. In this regard, the “Law Enforcement Mental Health and Wellness Act: Report to Congress” [13] highlighted the relative lack of mental health and wellness services available to unsworn compared to sworn professionals. Given that the majority of forensic science professionals in the current study were unsworn, the Report’s recommendation for expanding services to unsworn professionals appears justified. Based on the current findings, organizations need to carefully monitor stress in field-based professionals and devote resources to increasing resiliency in this group. That said, all three groups in the current study reported moderate levels of secondary traumatic stress and burnout, emphasizing that organizations need to assess all forensic scientists and devote resources accordingly.

The present study has several limitations. First, a relatively low response rate to the questionnaires (34%) with a smaller number providing complete data for statistical analysis (25%) limited the generalizability of the findings. Unfortunately, this has been the pattern in other studies of forensic science professionals where response rates have been even lower [36,44] or unspecified [32]. Second, because participants were permitted to designate that they worked in multiple disciplines as identified in Table 3, we could not establish relationships between disciplines and the subscales of the ProQOL. Future studies should address this question. Attention should also be focused on unique dimensions of forensic professional activity in medical examiner and coroner offices compared to crime laboratories.

Beyond limitations in the current study’s design and response rate, there were possible disincentives curtailing FSP participation in the study. Discussions with several of the facilities indicated that employees may fear negative consequences on their ability to testify or to be promoted if they acknowledged secondary traumatic stress of burnout, even with guarantees of confidentiality, much the way law enforcement officers are known to avoid seeking counseling for fear of an impact on their job status [13]. Efforts to change these perceptions and address other elements in the forensic science culture are needed to better assess employee stress and design effective interventions, aligning with recommendations that have also been made for law enforcement [13].

In conclusion, future research is needed to understand the specific elements and job responsibilities of field-based, laboratory-based, and managers that predict secondary traumatic stress, burnout, and compassion satisfaction. In addition to these cross-sectional assessments, future work should include longitudinal designs to define the impact of employee support strategies in areas of leadership, supervision, training, empowerment and work environment, and health and wellness on these responses over time. Given that high levels of employee secondary traumatic stress and burnout are known to result in lower productivity, increased risk of turnover, and impaired cognitive performance [5,20,33], the current findings support the need to devote scarce resources to address these issues. The VT-ORG for forensic professionals and the ProQOL modified for forensic professionals, available in the Appendix S1, as well as the OVC Vicarious Trauma Toolkit available online [45] are valuable tools for forensic organizations to advance policy and practice in addressing employee secondary traumatic stress and burnout.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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