VARIATION IN EMERGENCY MEDICAL SERVICES WORKPLACE SAFETY CULTURE

P. Daniel Patterson, PhD, MPH, EMT-B, David T. Huang, MD, MPH, Rollin J. Fairbanks, MD, MS, EMT-P, Scott Simeone, BS, MS, NREMT-P, Matthew Weaver, BS, NREMT-P, Henry E. Wang, MD, MS

ABSTRACT

Introduction. Workplace attitude, beliefs, and culture may impact the safety of patient care. This study characterized perceptions of safety culture in a nationwide sample of emergency medical services (EMS) agencies. **Methods.** We conducted a cross-sectional survey involving 61 advanced life support EMS agencies in North America. We administered a modified version of the Safety Attitudes Questionnaire (SAQ), a survey instrument measuring dimensions of workplace safety culture (Safety Climate, Teamwork Climate, Perceptions of Management, Job Satisfaction, Working Conditions, and Stress Recognition). We included full-time and part-time paramedics and emergency medical technicians. We determined the variation in safety culture scores across EMS agencies. Using hierarchical linear models, we determined associations between safety culture scores and individual and EMS agency characteristics. **Results.** We received 1,715 completed surveys from 61 EMS agencies (mean agency response rate 47%; 95% confidence interval [CI] 10%, 83%). There was wide variation in safety culture scores across EMS agencies [mean (minimum, maximum)]: Safety Climate 74.5 (min 49.9, max 89.7), Teamwork Climate 71.2 (min 45.1, max 90.1), Perceptions of Management 67.2 (min 31.1, max 92.2), Job Satisfaction 75.4 (min 47.5, max 93.8), Working Conditions 66.9 (min 36.6, max 91.4), and Stress Recognition 55.1 (min 31.3, max 70.6). Air medical EMS agencies tended to score higher across all safety culture domains. Lower safety culture scores were associated with increased annual patient contacts. Safety Climate domain scores were not associated with other individual or EMS agency characteristics. **Conclusion.** In this sample, workplace safety culture varies between EMS agencies. **Key words:** safety culture; teamwork; EMS; prehospital

PREHOSPITAL EMERGENCY CARE 2010;14:448–460

Received January 13, 2010, from the Department of Emergency Medicine and Center for Emergency Medicine of Western Pennsylvania, Inc. (PDP, DTH, SS, MW), University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania; the Department of Emergency Medicine (HEW), University of labama at Birmingham School of Medicine, Birmingham, Alabama; the Department of Critical Care Medicine and Clinical Research and Systems Modeling of Acute Illness Laboratory (DTH), University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania; and the Department of Emergency Medicine (RJF), University of Rochester School of Medicine, Rochester, New York. Revision received April 8, 2010; accepted for publication April 8, 2010.

Supported by grants from the MedEvac Foundation International (www.fareonline.org) and Pittsburgh Emergency Medicine Foundation (PEMF; www.pemf.net). During the execution of this study, Dr. Patterson was supported by the Emergency Medicine Patient Safety Foundation (EMPSF) and a Society for Academic Emergency Medicine (SAEM) Patient Safety Research Fellowship. Dr. Wang was supported by Clinical Scientist Development Award *K08*-HS013628 from the Agency for Healthcare Research and Quality, Rockville, Maryland. Dr. Patterson is currently supported by a KL2 grant (KL2 RR024154) from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH), and NIH Roadmap for Medical Research. Dr. Fairbanks is supported by a Career Development Award from the National Institute of Biomedical Imaging and Bioengineering (NIBIB), *K08*-EB009090. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official view of NCRR or NIH. Information on NCRR is available at http://www.ncrr.nih.gov/. Information on Re-engineering the Clinical Research Enterprise can be obtained at http://nihroadmap.nih.gov/clinicalresearch/overview-translational.asp.

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Address correspondence and reprint requests to: P. Daniel Patterson, PhD, Department of Emergency Medicine, University of Pittsburgh School of Medicine, 3600 Forbes Avenue, Iroquois Building, Suite 400A, Pittsburgh, PA 15261. e-mail: pattersond@upmc.edu

doi: 10.3109/10903127.2010.497900

INTRODUCTION

Organizational *safety culture* refers to the collective beliefs and perceptions of workers regarding the organization and safety of their workplace operations.[1] The Joint Commission, Agency for Healthcare Research and Quality, and Institute for Healthcare Improvement have all recommended frequent evaluations of organizational safety culture.[2–4] The National EMS Advisory Council called upon the emergency medical services (EMS) industry to develop a "culture of safety."[5] Research in high-reliability industries such as nuclear power and aviation have linked organizational safety culture to accidents, safety audit scores, and safety behavior.[1,6,7] Previous research of in-hospital environments link safety culture scores to patient outcomes.[8]

Preventable adverse events occur in one of every 1,000 air medical EMS transports.[9] A recent study has identified adverse events in ground EMS as well.[10] Prehospital airway management errors are common and potentially harmful.[11–13] Other studies and reviews highlight ambulance crashes, patient mishandling, malfunctioning equipment, medical mismanagement, and protocol deviations.[14–17] Emergency medical services personnel often report feeling stress and burnout.[18–21] Other studies suggest that many emergency medical technicians (EMTs) are concerned

about the accuracy of care decisions, they suffer from poor sleep quality and high fatigue, and they have a questionable commitment to their job.[22–24] Both inadequate sleep and fatigue have been linked to medical error and performance in physicians and nurses.[25–29] These observations suggest that EMS workplace culture may influence patient safety.

Prior studies have characterized organizational safety culture in the hospital inpatient setting, intensive care units (ICUs), nursing wards, ambulatory care, and skilled nursing facilities.[30–33] However, there have been no descriptions of safety culture in EMS. In this study we sought to characterize variation in workplace safety culture in EMS and test the psychometric properties of our survey tool.

Methods

Study Design

This study was approved by the University of Pittsburgh Institutional Review Board. We performed a cross-sectional survey of North American EMS agencies.

Study Setting

We enrolled a convenience sample of 62 EMS agencies from the United States and Canada. We selected only agencies that provided advanced life support care. While we did not utilize a formal sampling scheme, we tried to include agencies from a range of practice and geographic settings. Currently, there are no reliable and valid lists of all EMS agencies in the United States. Our strategy for recruitment included advertising on a single Web site and circulating a study flyer on popular EMS leadership e-mail Listservs.

Methods of Measurement

We measured organizational safety culture using a structured 60-question survey instrument, the Emergency Medical Services Safety Attitudes Questionnaire (EMS-SAQ), which has been previously described.[34] We developed the EMS-SAQ by modifying the Intensive Care Unit Safety Attitudes Questionnaire (ICU-SAQ), a widely used and validated survey instrument characterizing workplace safety culture in hospital critical care units.[31,35] Historically, the ICU-SAQ and related versions of the SAQ were based on the Flight Management Attitudes Questionnaire, which assessed airline cockpit safety culture.[30] The SAQ has been adapted for and validated in a range of medical settings such as ambulatory care, the operating room, the ICU, and skilled nursing facilities.[31–33,36] We chose to modify the ICU-SAQ over other safety culture tools because it is widely used across different health care settings.[37]

The ICU-SAQ used 30 core questions to characterize six safety domains: 1) Safety Climate (seven items), 2) Job Satisfaction (five items), 3) Perceptions of Management (four items), 4) Teamwork Climate (six items), 5) Working Conditions (four items), and 6) Stress Recognition (four items). We retained the same domains in the EMS-SAQ. We modified the wording to ensure consistency with EMS practice and convention. For example, we changed "*In the ICU, it is difficult to discuss mistakes.*" to "*At this EMS agency, it is difficult to discuss mistakes.*" Respondents provided answers to each question using a five-point Likert scale (strongly agree to strongly disagree; see Appendix 1).

We determined that our initial version of the EMS-SAQ had positive psychometric properties.[34] Specifically, tests revealed positive reliability and instrument validity scores. While we updated the instrument for this study, we did not alter the core questions of the survey.

Data Collection and Processing

Eligible respondents were identified by each EMS agency. An individual was eligible if he or she was a full-time, part-time, or volunteer paramedic, EMT, first responder, prehospital nurse, or EMS physician who worked an average of at least one EMS shift per week. We excluded all managerial, administrative, or clerical personnel.

We administered the survey using two modalities: 1) paper forms and 2) Internet-based survey. Each EMS agency selected the modality that it deemed most convenient; we permitted EMS agencies to use both modalities. The paper version of the survey consisted of questions printed in "bubble-sheet" format. Coordinators at each EMS agency supervised survey distribution. Respondents returned completed surveys in a self-addressed, postage-paid envelope.

We used a commercial survey vendor (www.keysurvey.com) to provide the electronic version of the survey. Each EMS agency provided the e-mail addresses for eligible employees. The vendor e-mailed a secure survey link to each potential participant. Up to three reminders were sent to nonrespondents.

Completion of the survey was voluntary. The paper survey did not contain individual identifiers, and the electronic version was de-identified by the vendor prior to analysis. We used a separate paper-based instrument completed by the agency contact to determine the characteristics of each EMS agency.

Outcome Measures

The primary outcomes were the survey scores for each safety domain: 1) Safety Climate (seven items), 2) Job Satisfaction (five items), 3) Perceptions of Management

(four items), 4) Teamwork Climate (six items), 5) Working Conditions (four items), and 6) Stress Recognition (four items). We calculated the score for each domain using the method prescribed by Sexton et al.[30] We first converted each Likert ranking to a point scale ranging from 0 to 100: disagree strongly = 0, disagree slightly = 25, neutral = 50, agree slightly = 75, and agree strongly = 100. We calculated the domain score by adding the individual response scores and dividing by the total number of items. For example, if a respondent answered disagree strongly, neutral, neutral, and agree slightly on the four items of Stress Recognition, the domain score would be 43.75.

Prior efforts also dichotomized the safety domain scores to "positive" (domain score ≥75) and "nonpositive" (domain score <75) responses.[30] For example, if a respondent's domain score for Teamwork Climate was 43.75, the respondent's responses were classified as "nonpositive." To count as positive, a respondent would need to respond with an average response of agree slightly or higher. Following prior approaches by Sexton et al.,[30] we examined these classifications as a proportion at the agency level and labeled it as the percentage of positive responses (PPR; see Appendix 2).

Independent Measures

The EMS agency demographics were collected from agency contacts and included agency type and geography, number of employees, number of annual patient contacts, agency affiliation, and percentage of patient contacts that were cardiac- or trauma-related. The EMS agencies designated their practice setting (i.e., rural ground, urban ground, air medical, or both ground and air medical). The EMS agencies also reported their number of employees (i.e., 1–20, 21–50, 51–100, or 101–400 employees), number of annual patient contacts (i.e., ≤2,500, 2,501–5,000, 5,001–10,000, or >10,000), affiliation (i.e., hospital-based model, fire-based model, third-service/government model, or private/freestanding model), and the percentage of annual patient contacts that were cardiac arrests or trauma (i.e., ≤2% or >2%).

Individual characteristics included age category (i.e., 18–30, 31–40, 41–50, or >50 years), total years of EMS experience (i.e., ≤5, 6–10, 11–15, 16–20, or >20), total years at the current EMS agency (i.e., ≤5, 6–10, or >10), position type (i.e., EMT-basic, EMT-intermediate, EMT-paramedic, prehospital nurse, or other), employment status (i.e., career full-time, career part-time, or volunteer), and education (i.e., some high school, high school graduate or General Educational Development [GED], some college, college [e.g., associate's degree or bachelor's degree], or college graduate level).

Primary Data Analysis

Like others before us,[8,30,32,38] we used confirmatory factor analysis (CFA) to determine whether the items administered to our targeted sample actually measured the hypothesized six-domain survey model. We used Cronbach's alpha to examine the intercorrelations among the six EMS-SAQ domains. Scores range from 0 to 100 for each domain, with higher values indicating that a set of items measure a single domain/construct.[39,40] Values lower than 0.70 raise questions about item wording and interpretation and whether the construct includes the appropriate number of items.[39] We evaluated three standard measures of model fit to determine whether our survey responses loaded onto a hypothesized six-domain survey structure: the root mean square error of approximation (RMSEA), Bentler's comparative fit index (CFI), and the Bentler and Bonett (1980) nonnormed fit index (NNFI).[40–42] An RMSEA less than 0.06 and a CFI and an NNFI greater than 0.9 are considered acceptable indexes of instrument validity and model fit.[40–42] The CFI and NNFI are less susceptible to sample size and considered complements of the RMSEA.[40–42]

We calculated mean domain scores and PPR for each individual EMS agency, depicting the variation graphically and with descriptive statistics. To identify potential associations between domain scores and individual and EMS agency characteristics, we used hierarchical linear models, modeling EMS agency as a fixed effect. For each characteristic, we fit two models: a linear model for the raw domain score and a logit model for the percentage of positive responses. We examined associations between the six EMS-SAQ domains and agency and individual demographic variables. We performed all analyses using SAS version 9.1 (SAS Institute, Inc., Cary, NC).

RESULTS

Of the 62 EMS agencies participating in the study, we excluded one agency because of low response rate (9.6%). The remaining 61 agencies were distributed across all 4 U.S. Census regions and included one EMS agency from Canada (Fig. 1). Most were rural–ground EMS agencies (Table 1). Most agencies employed between 21 and 50 employees and were private/freestanding model. Approximately 42% of all EMS agencies had ≤2,500 patient contacts in 2007.

We received 1,715 completed surveys from 61 agencies. The mean survey response rate per EMS agency was 47% (95% CI 10%, 83%). Response rates varied slightly by method for survey completion (paper only [$n = 16$] = 52%, combination of electronic and paper [$n = 3$] = 49%, and electronic only [$n = 42$] = 45%). We excluded 120 surveys that were missing two or more

TABLE 1. Demographics of Emergency Medical Services Agencies

Agency Characteristics	*n* (%) (Total *N* = 61)
Agency type and geography	
Rural ground	27(44.2%)
Urban ground	22(36.1%)
Air medical	9(14.8%)
Both ground and air medical	3(4.9%)
Number of employees	
1–20 employees	7(11.5%)
21–50 employees	31(50.8%)
51–100 employees	14(22.9%)
101–400 employees	9(14.8%)
Number of annual patient contacts	
≤2,500 patient contacts	26(42.6%)
2,501–5,000 patient contacts	16(26.2%)
5,001–10,000 patient contacts	7(11.5%)
>10,000 patient contacts	12(19.7%
Affiliation	
Hospital-based model	18(29.5%)
Fire-based model	7(11.5%)
Third-service/government model	12(19.7%)
Private/freestanding model	24(39.3%)
Percentage of patient contacts that were cardiac arrest or trauma	
≤2%	25(41.0%)
>2%	29(47.5%)
Did not report	7(11.3%)

One agency's data were excluded because of an extremely low response rate (9.6%).

demographic variables. The final analysis included 1,595 surveys.

In this sample of EMS personnel, the survey responses demonstrated good internal consistency (Cronbach's alpha for Safety Climate, alpha = 0.82; Teamwork Climate, alpha = 0.83; Perceptions of Management, alpha = 0.68; Job Satisfaction, alpha = 0.8; Working Conditions, alpha = 0.75, and Stress Recognition, alpha = 0.78). Instrument validity testing confirmed the presence of a six-domain structure and good model fit properties: RMSEA = 0.04, CFI = 0.97, NNFI = 0.95.

Most respondents were male and EMT-paramedic–certified (Table 2). The most common age stratums were 18–30 years (27.4%) and 31–40 years (37.3%). The most common stratum for total years of EMS experience was less than 5 years (28.5%). The most common stratum for total years of experience at the current EMS agency was less than 5 years (44.9%). Three-fourths of the respondents (77.6%) were career full-time employees and half (50.3%) had an associate's or bachelor's degree.

TABLE 2. Characteristics of the Survey Respondents

Characteristic	*n* (%) (Total *N* = 1,595*)
Gender—male	1, 141(73.2%)
Age	
18–30 years	437(27.4%)
31–40 years	595(37.3%)
41–50 years	360(22.6%)
>50 years	203(12.7%)
Total experience in EMS	
≤5 years	455(28.5%)
6–10 years	328(20.6%)
11–15 years	278(17.5%)
16–20 years	238(15.0%)
>20 years	293(18.4%)
Years at current EMS agency	
≤5 years	654(44.9%)
6–10 years	377(25.9%)
>11 years	425(29.2%)
Position type	
EMT–basic	309(19.4%)
EMT–intermediate	94(5.9%)
EMT–paramedic	990(62.1%)
Prehospital RN	127(8.0%)
Other	75(4.7%)
Employment status	
Career full-time	1, 223(77.6%)
Career part-time	324(20.6%)
Volunteer	29(1.8%)
Education	
Some high school or high school graduate or GED	119(7.6%)
Some college	585(36.7%)
College (AD or bachelor's)	802(50.3%)
College (graduate)	72(4.5%)

*Of the 1,754 surveys available for analysis, we excluded 39 from one agency because of a very low agency response rate (9.6%) and 120 surveys with missing data for two or more variables. Stratum frequencies take into account missing values. Specifically, of the 1,595 surveys analyzed, 2.3% were missing gender, 0.2% were missing years of EMS experience, 8.7% were missing years at the agency, 1.2% were missing full-time status, and 1.1% were missing education.

AD = associate's degree; EMS = emergency medical services; EMT = emergency medical technician; GED = General Educational Development; RN = registered nurse.

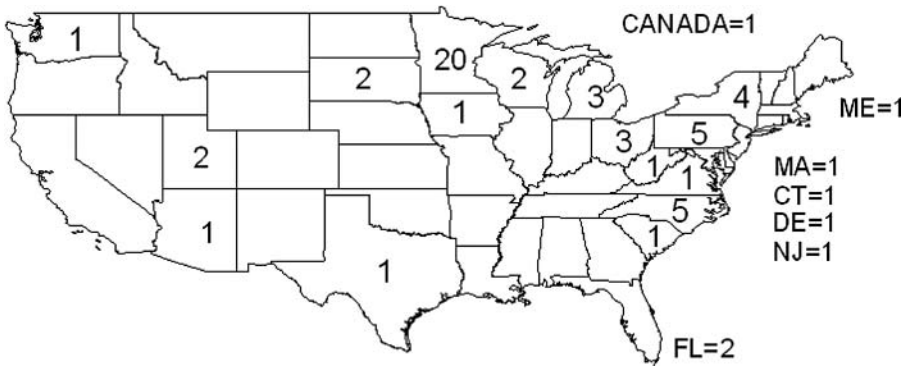

FIGURE 1. Map of the participating emergency medical services agencies (*n* = 61). Alaska and Hawaii are not shown. CT = Connecticut; DE = Delaware; FL = Florida; MA = Massachusetts; ME = Maine; NJ = New Jersey.

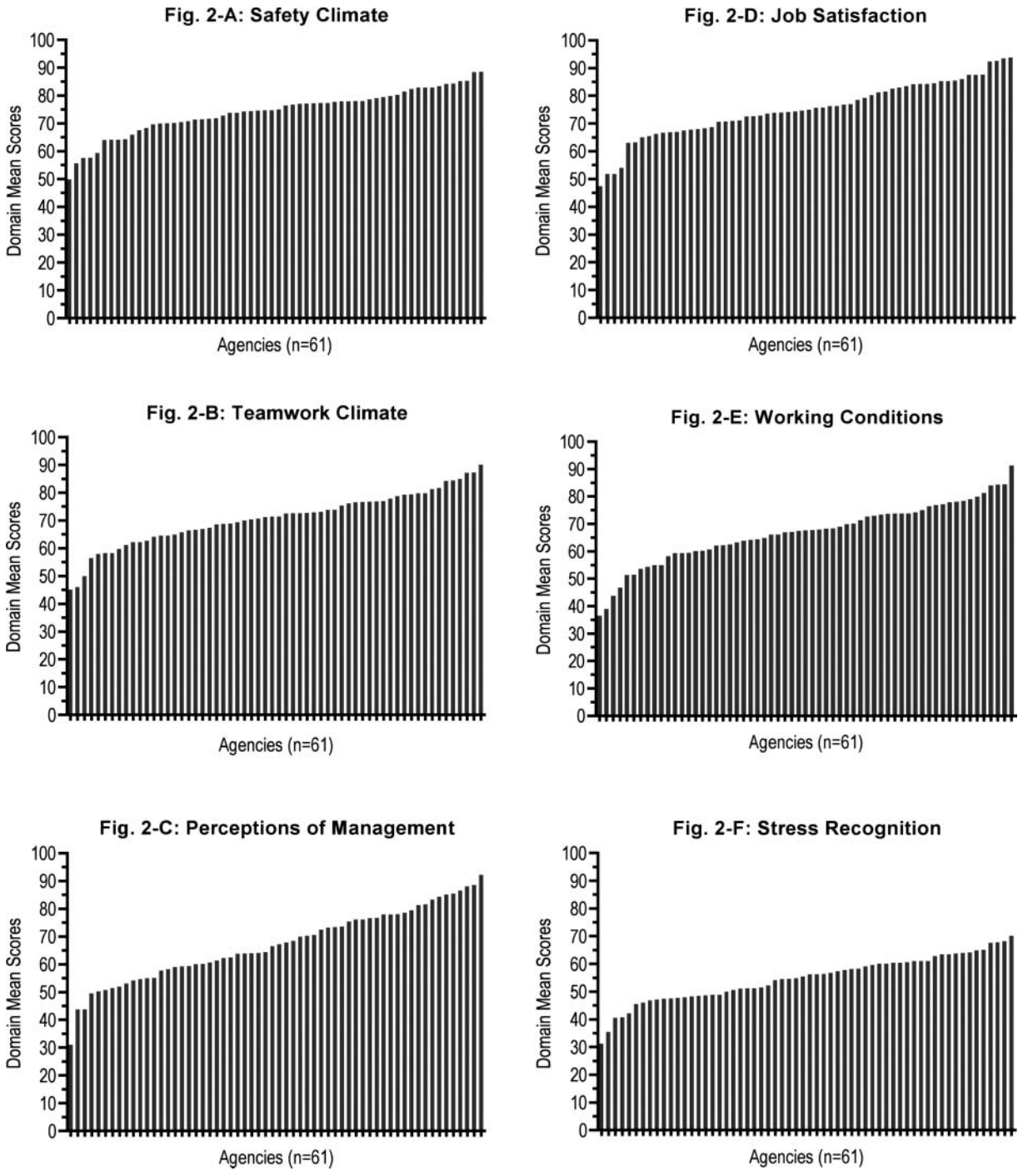

FIGURE 2. Mean domain scores across agencies for the six Emergency Medical Services Safety Attitudes Questionnaire domains.

Agency mean domain scores varied across EMS agencies (Fig. 2): Safety Climate 74.5 (95% CI 72.4, 76.6; minimum 49.9, maximum 89.7), Teamwork Climate 71.2 (95% CI 68.6, 73.7; min 45.1, max 90.1), Perceptions of Management 67.2 (95% CI 63.9, 70.5; min 31.1, max 92.2), Job Satisfaction 75.4 (95% CI 72.8, 78.0; min 47.5, max 93.8), Working Conditions 66.9 (95% CI 64.0, 69.7; min 36.6, max 91.4), and Stress Recognition 55.1 (95% CI 52.9, 57.2; min 31.3, max 70.6).

The mean Safety Climate score for air-medical EMS agencies was greater than mean scores in private/freestanding and fire-based model agencies (Table 3). The mean Safety Climate score was also highest in agencies with fewer employees, agencies with lower annual patient contacts, and agencies with a higher proportion of acute patients.

The percentage of respondents with a positive perception (PPR) varied across EMS agencies for each domain: Safety Climate 58.6% (95% CI 52.7, 64.5; min 0%, max 100%), Teamwork Climate 52.8% (95% CI 46.5, 59.1; min 0%, max 100%), Perceptions of Management 43.8% (95% CI 36.7, 50.9; min 0%, max 90%), Job

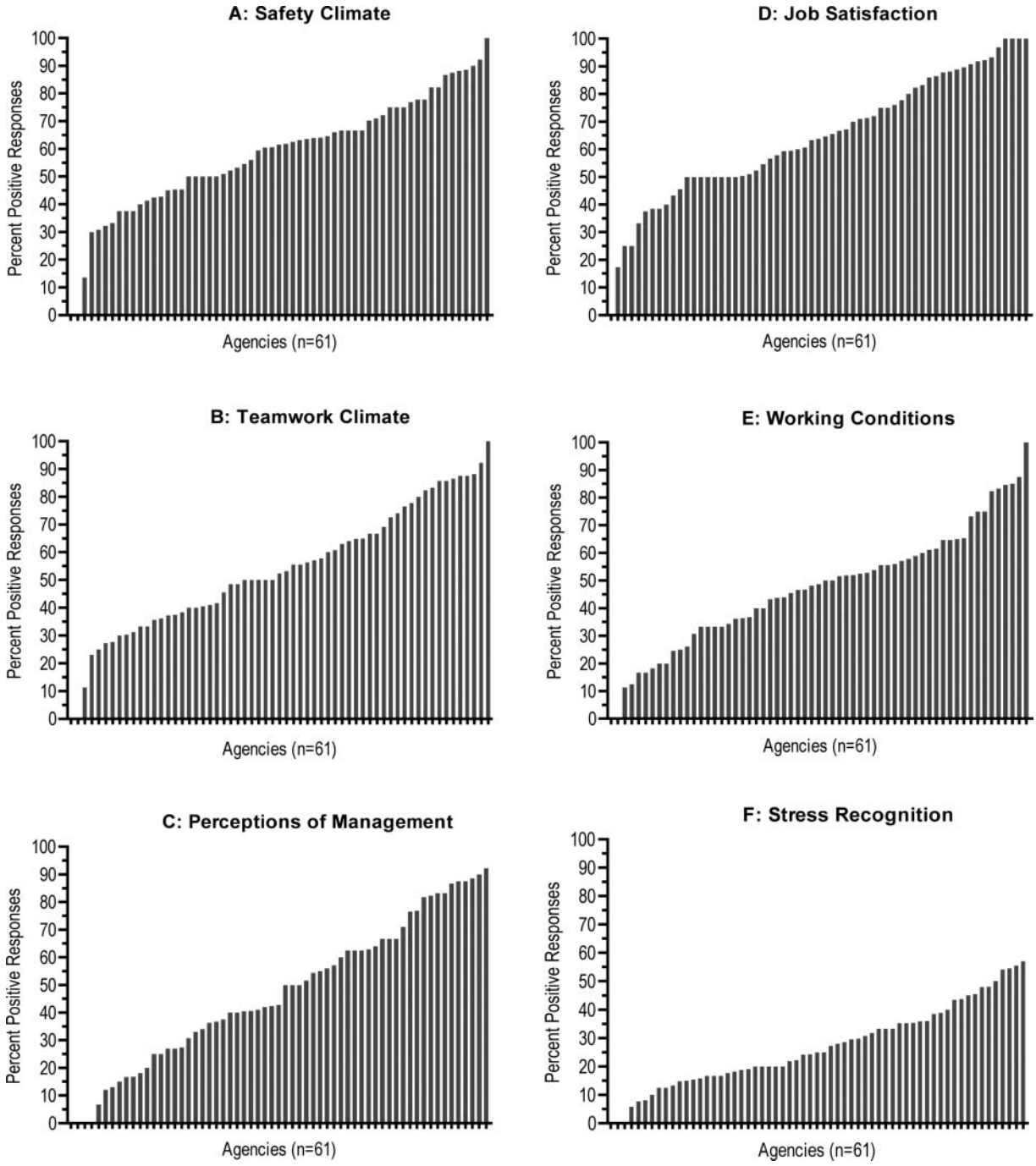

FIGURE 3. Percentage of positive responses across agencies for the six Emergency Medical Services Safety Attitudes Questionnaire domains.

Satisfaction 63.4% (95% CI 57.5, 69.4; min 0%, max 100%), Working Conditions 46.3% (95% CI 41.4, 51.3; min 0%, max 100%), and Stress Recognition 28.6% (95% CI 25.2, 32.0; min 0%, max 57.1%) (Fig. 3).

The PPR for Safety Climate was highest among air-medical-only agencies, but did not differ significantly across categories of model affiliation (Table 4). A lower proportion of EMS agency patient contacts was associated with increased PPR for Safety Climate. The EMS agencies with 2% or more trauma- and cardiac-related patient contacts had a higher PPR than those agencies with less than 2%. Notably, the PPR for Stress Recognition did not vary across any of the selected agency characteristics.

The mean Safety Climate score was lower for EMT-paramedics than the mean score for all other position types (Table 5). The mean Safety Climate scores were highest among respondents between the ages of 41 and 50 years, highest among respondents with less experience in EMS, and highest among respondents with less experience at the current EMS agency of employment when compared with their respective referent groups.

TABLE 3. Variations in the Emergency Medical Services Safety Attitudes Questionnaire Domain Mean Scores across Agency Characteristics

	Safety Climate Mean (95% CI)	Teamwork Climate Mean (95% CI)	Perceptions of Management Mean (95% CI)	Job Satisfaction Mean (95% CI)	Working Conditions Mean (95% CI)	Stress Recognition Mean (95% CI)
Study sample	74.5 (72.4, 76.6)	71.2 (68.6, 73.7)	67.2 (63.9, 70.5)	75.4 (72.8, 78.0)	66.9 (64.0, 69.7)	55.1 (52.9, 57.2)
Agency type and geography	*	†	†	NS	†	†
Rural ground	74.5 (72.8, 76.2)	71.0 (68.8, 73.1)	69.2 (67.1, 71.3)	76.7 (74.7, 78.7)	67.4 (65.3, 69.6)	52.2 (49.7, 54.6)
Urban ground	72.2 (71.0, 73.4)	68.9 (67.5, 70.2)	61.2 (59.8, 62.7)	73.3 (71.9, 74.6)	64.5 (63.1, 66.0)	57.2 (55.6, 58.7)
Air medical only	82.9 (80.9, 84.8)	79.5 (77.3, 81.6)	78.3 (75.9, 80.6)	81.3 (79.1, 83.5)	73.3 (70.9, 75.7)	57.1 (54.4, 59.9)
Both ground and air medical	75.1 (71.5, 78.7)	71.8 (67.5, 76.2)	64.3 (59.3, 69.3)	75.8 (71.7, 79.8)	65.6 (60.8, 70.4)	57.6 (52.5, 62.7)
Model affiliation	*	*	†	*	*	†
Hospital-based	70.8 (69.0, 72.5)	67.2 (65.3, 69.2)	63.7 (61.4, 66.0)	73.7 (71.8, 75.6)	61.6 (59.4, 63.8)	53.8 (51.6, 56.0)
Fire-based	76.0 (74.0, 78.0)	75.1 (72.9, 77.3)	65.7 (63.2, 68.2)	81.9 (79.7, 84.1)	68.9 (66.4, 71.3)	54.7 (51.7, 57.6)
Third-service/government	74.9 (73.5, 76.3)	71.0 (69.4, 72.7)	64.9 (63.2, 66.6)	74.6 (72.9, 76.3)	68.9 (67.2, 70.6)	57.3 (55.2, 59.4)
Private/freestanding	76.6 (74.9, 78.3)	72.4 (70.5, 74.4)	69.2 (67.2, 71.3)	73.6 (71.6, 75.6)	67.9 (65.8, 69.9)	58.0 (55.8, 60.1)
Number of employees	*	*	*	*	*	NS
1–20	77.4 (72.2, 82.6)	76.2 (69.7, 82.6)	71.7 (64.8, 78.5)	78.8 (72.9, 84.8)	69.8 (62.7, 76.9)	54.5 (46.5, 62.5)
21—50	76.5 (75.0, 78.0)	72.3 (70.6, 74.1)	70.9 (69.1, 72.7)	76.2 (74.6, 77.9)	69.7 (67.9, 71.5)	55.0 (53.0, 57.0)
51–100	75.1 (73.4, 76.7)	72.9 (71.0, 74.8)	67.4 (65.4, 69.4)	78.8 (77.0, 80.7)	66.7 (64.7, 68.7)	56.9 (54.7, 59.1)
101–400	71.9 (70.6, 73.3)	68.1 (66.6, 69.7)	60.4 (58.6, 62.1)	71.5 (69.9, 73.0)	63.6 (61.9, 65.3)	56.6 (54.8, 58.4)
Number of patient contacts in 2007	*	*	*	*	*	†
≤2,500	78.2 (76.7, 79.7)	75.0 (73.3, 76.7)	74.3 (72.5, 76.0)	80.3 (78.7, 81.9)	71.1 (69.3, 72.9)	54.4 (52.3, 56.5)
2,501–5,000	76.2 (74.3, 78.1)	72.9 (70.7, 75.1)	71.0 (68.8, 73.2)	78.5 (76.4, 80.6)	69.3 (67.1, 71.5)	54.3 (51.6, 57.0)
5,001–10,000	76.1 (74.0, 78.2)	72.9 (70.4, 75.4)	63.5 (60.7, 66.3)	75.1 (72.5, 77.7)	65.3 (62.7, 68.0)	56.6 (53.5, 59.6)
10,001+	69.6 (68.1, 71.0)	65.8 (64.1, 67.5)	57.3 (55.6, 59.1)	69.2 (67.6, 70.9)	61.8 (60.0, 63.6)	58.3 (56.4, 60.1)
Percentage of patient contacts that were cardiac or trauma related	*	*	*	*	*	NS
≤2%	71.5 (70.2, 72.8)	67.6 (66.0, 69.2)	62.5 (60.9, 64.1)	72.8 (71.2, 74.4)	63.2 (61.6, 64.9)	55.7 (53.9, 57.4)
>2%	76.4 (75.2, 77.6)	73.1 (71.7, 74.4)	67.9 (66.4, 69.5)	76.2 (74.9, 77.5)	69.0 (67.5, 71.7)	56.6 (54.9, 58.2)

*Indicates significance at $p < 0.0001$.
†Indicates significant differences in domain mean scores across different levels of a variable $p < 0.05$.
CI = confidence interval; EMS = emergency medical services; NS = no significant differences identified.

The PPR for Safety Climate did not differ across most respondent demographic factors (Table 6). The PPR for Safety Climate was highest among prehospital nurses and other positions and was lowest among paramedics ($p < 0.0001$; Table 6). The PPR for other domains of safety culture varied across some, but not all, respondent demographic characteristics. Notably, the PPR for Stress Recognition varied across one of the seven measured respondent demographics, education. The PPR for Stress Recognition increased with categories of higher education.

DISCUSSION

This study proposes and tests a survey adapted for EMS from a previously validated safety culture survey. Safety culture assessments are now common practice across most health care organizations. These assessments serve multiple purposes, including setting safety benchmarks, targeting problem areas, evaluating programs, and meeting regulatory requirements. In this study sample, we observed wide interagency variation in workplace safety culture. Scores at the lower end of this variation raise the question: Is the patient's safety much more susceptible in these EMS agencies than in agencies with higher EMS-SAQ scores? Conversely, do higher scores suggest that select EMS agencies hold a greater awareness of safety and practice accordingly?

Wide variation in workplace safety culture is not surprising given that the EMS work environment contains many threats to patient and provider safety. Suyama et al. showed that in one urban environment, injury rates associated with lost time at work were higher among paramedics and EMTs than fire and police.[43] In a study of two urban EMS agencies, Maguire et al. determined that the risk of injury among EMS personnel was 1.5 times higher than that for firefighters, 5.8 times higher than that for health services personnel, and 7 times higher than the national average reported by the U.S. Department of Labor.[44] Other studies show that many EMS personnel often deviate from written protocols, fail to properly secure patient airways, experience high levels of stress and burnout, suffer from poor sleep quality and high fatigue, and have a questionable commitment to the profession.[15,19,24,45–48] When combined, these factors may surface as nonpositive perceptions of worker safety culture.[49]

Prior safety culture studies have identified a pattern of variation in safety culture scores across settings. In

TABLE 4. Variations in the Percentage of Positive Responses across Agency Characteristics

	Safety Climate	Teamwork Climate	Perceptions of Management	Job Satisfaction	Working Conditions	Stress Recognition
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Study sample	58.6 (52.7, 64.5)	52.8 (46.5, 59.1)	43.8 (36.7, 50.9)	63.4 (57.5, 69.4)	46.3 (41.4, 51.3)	28.6 (25.2, 32.0)
Agency type and geography	*	†	†	NS	NS	NS
Rural ground	57.9 (52.1, 63.8)	52.1 (45.3, 59.0)	49.5 (41.0, 58.0)	66.4 (57.0, 75.8)	47.1 (39.1, 55.1)	23.3 (18.0, 28.7)
Urban ground	54.0 (45.2, 62.8)	47.9 (38.9, 56.8)	33.4 (25.9, 40.9)	59.2 (50.7, 67.7)	43.2 (36.3, 50.2)	29.9 (25.6, 34.1)
Air medical only	75.9 (66.7, 85.2)	71.1 (61.2, 80.9)	70.7 (58.0, 83.3)	75.2 (63.4, 87.0)	57.9 (48.6, 67.2)	31.2 (19.4, 43.0)
Both ground and air medical	59.5 (46.7, 72.2)	54.1 (46.2, 61.9)	45.2 (38.3, 52.1)	63.0 (55.4, 70.6)	42.5 (27.2, 57.8)	32.4 (14.8, 50.1)
Model affiliation	NS	NS	NS	NS	NS	NS
Hospital-based	50.4 (39.7, 61.1)	44.4 (34.9, 53.9)	41.5 (29.6, 53.4)	57.1 (46.7, 67.4)	38.0 (29.1, 46.9)	25.3 (20.1, 30.5)
Fire-based	61.1 (53.1, 69.1)	60.3 (48.7, 72.0)	36.1 (20.7, 48.8)	75.8 (64.2, 87.4)	48.4 (38.6, 58.3)	23.8 (15.3, 32.3)
Third-service/government	56.1 (45.8, 66.4)	49.6 (38.8, 60.4)	38.4 (27.9, 48.8)	61.8 (52.5, 71.2)	46.9 (38.1, 55.6)	29.1 (23.9, 34.4)
Private/freestanding	61.7 (52.8, 70.7)	54.3 (44.2, 64.5)	51.0 (39.0, 62.9)	57.7 (47.5, 67.9)	47.4 (38.3, 56.4)	32.1 (24.2, 40.0)
Number of employees	NS	NS	*	*	NS	NS
1–20	58.1 (36.9, 79.4)	62.8 (41.2, 84.4)	51.2 (24.3, 78.1)	69.8 (51.9, 87.6)	51.2 (23.6, 78.7)	27.9 (9.9, 45.9)
21—50	61.2 (55.7, 66.6)	53.9 (48.1, 59.7)	53.9 (46.1, 61.7)	62.8 (55.8, 69.8)	50.1 (44.4, 55.8)	27.2 (22.3, 32.2)
51—100	59.0 (49.6, 68.4)	54.8 (43.7, 65.8)	43.7 (29.3, 58.0)	69.4 (58.5, 80.3)	44.8 (35.2, 54.4)	29.3 (21.3, 37.2)
101—400	51.6 (41.0, 62.3)	45.4 (34.5, 56.3)	31.5 (23.1, 39.9)	54.3 (45.9, 62.7)	40.0 (31.7, 48.0)	28.1 (22.6, 33.5)
Number of patient contacts in 2007	*	*	†	*	*	NS
≤2,500	65.1 (58.1, 72.0)	58.3 (49.6, 67.1)	59.5 (50.0, 69.0)	70.6 (64.3, 76.9)	53.0 (46.9, 59.1)	24.6 (18.3, 30.9)
2,501–5,000	62.8 (56.1, 69.5)	56.0 (47.4, 64.5)	50.6 (39.0, 62.2)	67.9 (59.4, 76.3)	50.3 (42.7, 57.9)	27.1 (19.8, 34.4)
5,001–10,000	55.2 (46.6, 63.7)	56.0 (45.4, 66.5)	35.3 (22.4, 32.5)	61.1 (45.4, 76.8)	40.1 (29.9, 50.3)	29.4 (18.6, 40.1)
10,001+	47.5 (36.9, 58.1)	40.4 (30.6, 50.3)	27.0 (21.5, 32.5)	50.6 (41.9, 59.2)	36.9 (28.4, 45.4)	31.0 (25.8, 36.2)
% of patient contacts that were cardiac or trauma related	*	*	*	NS	NS	NS
≤2%	49.4 (43.2, 55.6)	42.6 (36.5, 48.7)	33.7 (25.3, 42.1)	55.8 (47.4, 64.2)	38.2 (31.7, 44.8)	25.4 (20.9, 29.8)
>2%	61.9 (54.4, 69.4)	56.4 (48.3, 64.5)	47.5 (38.4, 56.7)	64.3 (57.0, 71.5)	49.2 (43.4, 55.0)	30.4 (25.1, 35.7)

*Indicates significant differences in domain proportions across different levels of a variable $p < 0.05$.
†Indicates significance at $p < 0.0001$.
CI = confidence interval; NS = no significant differences identified.

an international study of safety culture, Sexton and colleagues identified wide variation in safety culture scores across 203 clinical units (i.e., operating rooms, ambulatory care settings, and ICUs).[30] A statewide study of ICU safety culture in Michigan revealed wide variation in scores across ICUs in a single state.[8] Positive perceptions of teamwork climate ranged from a low of 16% to 92%. In a study of four ICUs, Huang et al. discovered significant variation in scores within a single institution, with positive perceptions of safety climate ranging from approximately 30% to 50% and positive perceptions of job satisfaction ranging from 20% to 70% across ICUs.[31] In this context, our observation of wide safety culture variation across EMS agencies is not surprising. Potential factors underlying culture variation include regional practice differences, varying economic resources, and different leadership structure and styles.

A common mechanism for error or adverse event classification and reporting does not exist. Measurement of adverse events and medical errors in EMS is difficult. Research by Hobgood et al. suggests that there is limited reliability and accuracy in paramedics' and EMTs' self-reporting of errors.[50] Threats to safety may be present without actual errors or adverse events. While we believe that culture instruments could complement—but should not replace—direct measurement of adverse events, culture is a potential contributor to poor safety.[51] The overall utility of workplace safety culture instruments may lie in their ability to highlight safety conditions at individual EMS agencies. The EMS-SAQ offers a novel approach to patient safety, providing a barometer of safety attitudes rather than direct measures such as errors or adverse events.

LIMITATIONS

While our convenience sample may not represent all ALS-level EMS agencies in North America, few sampling alternatives exist. A valid and reliable list of all EMS agencies in the United States does not exist. Sampling individual EMS personnel akin to the National Registry's Longitudinal Emergency Medical Technician Attributes and Demographics Study (LEADS) is not appropriate for studies of workplace safety culture.

Approximately 32% of our study sample includes EMS agencies from Minnesota. Among these agencies, mean domain scores were slightly lower for five of the six domains compared with all other agencies: Safety Climate (70.7 vs. 76.6; $p = 0.006$), Teamwork Climate (66.6 vs. 73.7; $p = 0.005$), Stress Recognition (51.0 vs. 57.4; $p = 0.003$), Perceptions of Working Conditions (61.7 vs. 69.7; $p = 0.005$), Perceptions of Management (63.9 vs. 68.9; $p = 0.141$), and Job Satisfaction (71.8 vs. 77.4; $p = 0.041$). Findings should not be interpreted as representative of EMS nationwide.

TABLE 5. Variations in the Emergency Medical Services Safety Attitudes Questionnaire Domain Mean Scores across Individual Characteristics

Characteristic	Safety Climate	Teamwork Climate	Perceptions of Management	Job Satisfaction	Working Conditions	Stress Recognition
Gender	NS	NS	NS	NS	NS	NS
Female	73.8 (72.0, 75.5)	69.7 (67.6, 71.8)	66.2 (64.0, 68.5)	75.4 (73.5, 77.3)	66.2 (64.1, 68.3)	57.6 (55.3, 59.9)
Male	75.0 (73.9, 76.0)	71.9 (70.7, 73.0)	66.0 (64.7, 67.2)	75.7 (74.4, 76.8)	67.1 (65.9, 68.3)	55.3 (54.0, 56.7)
Age	*	*	*	NS	*	NS
18–30 years	72.7 (71.0, 74.4)	68.2 (66.3, 70.2)	62.9 (60.8, 64.9)	74.2 (72.2, 76.1)	64.7 (62.6, 66.7)	54.8 (52.5, 57.0)
31–40 years	75.2 (73.8, 76.6)	71.5 (69.9, 73.1)	66.4 (64.6, 68.1)	76.3 (74.7, 77.9)	66.0 (64.2, 67.7)	55.8 (53.9, 57.7)
41–50 years	76.0 (74.2, 77.8)	73.4 (71.3, 75.5)	68.3 (66.0, 70.6)	76.3 (74.3, 78.4)	69.5 (67.3, 71.7)	56.4 (53.9, 58.8)
>50 years	75.1 (72.6, 77.6)	73.3 (70.6, 76.1)	68.6 (65.4, 71.9)	74.9 (71.9, 77.8)	68.6 (65.5, 71.7)	58.5 (55.3, 61.6)
Total experience in EMS	*	*	*	NS	*	NS
≤5 years	76.6 (75.0, 78.1)	72.0 (70.2, 73.9)	68.0 (66.0, 70.1)	77.2 (75.3, 79.1)	68.2 (66.3, 70.1)	55.3 (53.0, 57.6)
6–10 years	72.6 (70.6, 74.6)	68.7 (66.4, 71.1)	63.1 (60.6, 65.5)	74.7 (72.5, 77.0)	64.5 (62.0, 67.0)	56.8 (54.3, 59.4)
11–15 years	75.7 (73.6, 77.7)	73.2 (70.9, 75.4)	66.9 (64.3, 69.5)	77.0 (74.8, 79.2)	69.1 (66.8, 71.3)	54.8 (52.1, 57.5)
16–20 years	72.9 (70.5, 75.4)	69.7 (67.2, 72.2)	65.3 (62.5, 68.1)	73.2 (70.7, 75.8)	63.5 (60.5, 66.5)	55.3 (52.3, 58.3)
>20 years	74.7 (72.7, 76.7)	72.8 (70.4, 75.1)	66.8 (64.2, 69.5)	74.7 (72.4, 77.1)	67.8 (65.3, 70.3)	57.8 (55.1, 60.5)
Years at current EMS agency	*	NS	*	*	NS	NS
≤5 years	75.8 (74.5, 77.1)	71.9 (70.3, 73.4)	67.2 (65.5, 68.9)	76.8 (75.2, 78.3)	67.3 (65.6, 69.0)	55.1 (53.2, 57.0)
6–10 years	73.7 (71.8, 75.6)	69.7 (67.6, 71.8)	64.4 (62.1, 66.7)	74.7 (72.7, 76.7)	65.8 (63.7, 68.0)	56.2 (53.9, 58.6)
≥11 years	73.1 (71.4, 74.8)	70.4 (68.5, 72.3)	63.6 (61.5, 65.7)	72.5 (70.5, 74.5)	65.1 (63.0, 67.1)	57.6 (55.4, 59.8)
Position type	†	†	†	†	†	NS
EMT–basic	76.4 (74.5, 78.3)	73.7 (71.5, 75.9)	67.3 (64.8, 69.8)	79.3 (77.2, 81.4)	69.1 (66.7, 71.5)	54.0 (51.2, 56.7)
EMT–intermediate	73.6 (70.2, 76.9)	69.5 (65.7, 73.3)	67.4 (63.0, 71.7)	76.7 (72.6, 80.8)	66.3 (61.9, 70.7)	54.2 (49.3, 59.1)
EMT–paramedic	72.6 (71.5, 73.7)	69.0 (67.7, 70.3)	63.2 (61.9, 64.6)	72.8 (71.5, 74.1)	64.8 (63.4, 66.1)	56.1 (54.7, 57.6)
Prehospital RN	81.9 (79.2, 84.8)	78.3 (74.9, 81.8)	77.5 (73.6, 81.3)	81.9 (78.6, 85.1)	71.4 (67.5, 75.3)	60.3 (56.0, 64.5)
Other	84.3 (80.8, 87.8)	81.9 (78.3, 85.6)	78.8 (74.3, 83.2)	84.5 (81.0, 88.1)	75.8 (72.0, 79.7)	57.6 (51.9, 63.2)
Full-time status	NS	*	*	NS	*	NS
Career full-time	74.2 (73.2, 75.2)	70.8 (69.6, 71.9)	65.0 (63.8, 66.3)	75.0 (73.9, 76.2)	65.8 (64.6, 67.1)	56.1 (54.7, 57.3)
Part-time	76.2 (74.3, 78.1)	72.5 (70.4, 74.6)	70.0 (67.7, 72.3)	76.9 (74.7, 79.0)	69.1 (66.8, 71.4)	55.9 (53.2, 58.6)
Volunteer	79.5 (74.7, 84.2)	80.2 (73.7, 86.8)	70.8 (64.0, 77.5)	82.9 (77.9, 87.8)	76.1 (69.6, 82.6)	60.5 (52.2, 68.8)
Education	NS	NS	NS	NS	NS	*
Some high school, high school graduate, or GED	76.0 (72.7, 79.3)	72.0 (68.1, 75.8)	66.3 (62.3, 70.4)	74.9 (71.1, 78.8)	68.8 (65.1, 72.4)	52.5 (48.2, 56.9)
Some college	74.5 (73.1, 75.9)	70.6 (69.0, 72.2)	64.5 (62.7, 66.3)	75.4 (73.8, 77.0)	67.2 (65.5, 69.0)	53.9 (51.9, 55.9)
College (AD or bachelor's)	74.6 (73.3, 75.9)	71.6 (70.2, 73.0)	67.0 (65.4, 68.5)	75.7 (74.3, 77.1)	66.2 (64.6, 67.7)	57.8 (56.2, 59.4)
College (graduate)	75.2 (71.3, 79.2)	71.7 (67.0, 76.4)	68.5 (63.1, 73.9)	74.9 (70.1, 79.7)	64.4 (59.8, 69.1)	58.9 (53.5, 64.3)

*Indicates significant differences in domain mean scores across different levels of a variable $p < 0.05$.
†Indicates significance at $p < 0.0001$.
AD = associate's degree; EMS = emergency medical services; EMT = emergency medical technician; GED = General Educational Development; NS = no significant differences identified; RN = registered nurse.

Response rates across EMS agencies were similar to other studies of EMS agencies and individual EMS workers.[46,52] Notably, we observed a slightly better average response rate in this study compared with those of other multisite studies of safety culture.[53–56] Individual agency response rates below 60% may reduce the accuracy of perceptions of safety.[57] In our study, agencies with ≥60% ($n = 12$) agency-level response rates were not significantly different ($p > 0.05$) from agencies with a response rate ≤59% ($n = 49$) when comparing agency type and geography, number of employees, total patient contacts, or percentage of patient contacts that were cardiac arrest or trauma. However, mean domain scores for Perceptions of Management and Job Satisfaction were lower among agencies with a lower response rate than among agencies with a higher response rate ($p < 0.05$).

Both respondent and agency factors may help explain differences in EMS-SAQ scores and thus represent residual confounding. Our study was not designed to identify a likely list of agency and respondent characteristics predictive of variations in safety culture scores. Rather, the primary purpose of our study was to characterize safety culture in the EMS setting using a reliable and valid measure of safety culture. Nonetheless, we conducted additional analyses to test for such differences, which may be used to develop testable hypotheses in future research. We employed 12 hierarchical linear models with the six EMS-SAQ domain mean scores and six PPR proportions as outcomes and agency and individual variables as independent variables. We found few and potentially clinically insignificant differences in EMS-SAQ scores across agency and individual characteristics.

We did not examine the linkage between EMS-SAQ scores and adverse events or medical errors as in a recent study of safety culture.[8] Exploring this linkage in EMS would be methodologically difficult.

TABLE 6. Variations in the Percentage of Positive Responses Across Individual Characteristics

Characteristic	Safety Climate	Teamwork Climate	Perceptions of Management	Job Satisfaction	Working Conditions	Stress Recognition
Gender	NS	NS	NS	NS	NS	*
Female	57.1 (49.2, 64.9)	49.8 (41.5, 58.0)	45.6 (37.0, 54.1)	64.7 (58.6, 70.9)	43.4 (36.6, 50.2)	33.8 (28.2, 39.4)
Male	59.5 (53.8, 65.1)	54.4 (48.3, 60.4)	43.2 (35.7, 50.6)	63.5 (57.1, 70.0)	47.8 (42.7, 52.9)	26.8 (23.4, 30.2)
Age	NS	*	*	NS	NS	NS
18–30 years	53.9 (43.3, 64.5)	46.0 (37.0, 54.9)	37.3 (30.2, 44.5)	60.7 (52.8, 68.7)	42.7 (35.7, 49.8)	26.1 (22.0, 30.3)
31–40 years	59.9 (53.3, 66.6)	53.3 (46.3, 60.3)	42.7 (33.9, 51.5)	66.3 (59.4, 73.3)	45.1 (39.0, 51.2)	28.6 (24.6, 32.7)
41–50 years	61.8 (55.8, 67.9)	58.7 (51.1, 66.3)	49.4 (41.1, 57.8)	64.1 (56.9, 71.4)	51.0 (43.8, 58.2)	29.8 (24.2, 35.4)
>50 years	60.9 (52.3, 69.5)	57.6 (50.9, 64.4)	52.7 (43.3, 62.2)	62.1 (52.5, 71.6)	51.2 (43.4, 59.0)	32.2 (24.7, 39.7)
Total experience in EMS	NS	*	*	NS	NS	NS
≤5 years	63.2 (54.9, 71.5)	52.1 (44.1, 60.1)	46.9 (38.8, 55.0)	66.4 (58.4, 74.5)	47.3 (40.2, 54.5)	29.0 (24.4, 33.6)
6–10 years	56.7 (48.6, 64.9)	47.4 (40.3, 54.5)	37.8 (29.4, 46.3)	63.0 (55.1, 70.8)	46.0 (38.8, 53.2)	28.7 (24.1, 33.4)
11–15 years	61.6 (53.2, 70.1)	59.0 (51.2, 66.8)	47.0 (37.7, 56.2)	67.3 (60.0, 74.6)	46.8 (40.1, 53.4)	25.9 (20.8, 31.0)
16–20 years	52.9 (45.1, 60.8)	49.4 (39.0, 59.7)	40.1 (30.9, 49.2)	57.4 (48.7, 66.1)	43.9 (35.6, 52.2)	27.7 (21.1, 34.4)
>20 years	57.2 (50.6, 63.8)	58.8 (51.7, 65.8)	47.4 (38.8, 56.1)	63.0 (54.7, 71.3)	48.5 (42.1, 54.8)	31.7 (25.4, 38.1)
Years at current EMS agency	NS	NS	NS	NS	NS	NS
≤5 years	61.4 (54.0, 68.8)	53.0 (46.0, 59.9)	46.1 (37.0, 55.2)	65.2 (58.4, 71.9)	48.2 (41.6, 54.9)	27.9 (23.7, 32.1)
6–10 years	58.3 (51.2, 65.4)	53.9 (46.1, 61.6)	40.8 (31.9, 49.7)	63.9 (55.6, 72.2)	42.6 (36.7, 48.6)	28.9 (23.6, 34.2)
≥11 years	53.5 (45.9, 61.1)	49.8 (41.7, 57.9)	39.6 (30.9, 48.4)	58.1 (48.9, 67.2)	42.8 (35.8, 49.9)	30.4 (25.3, 35.4)
Position type	†	†	†	†	*	NS
EMT–basic	63.5 (54.6, 72.5)	59.0 (48.7, 69.4)	47.4 (37.8, 56.9)	72.6 (62.4, 82.9)	52.1 (44.4, 59.8)	25.1 (20.6, 29.6)
EMT–intermediate	59.6 (49.4, 69.8)	48.9 (37.9, 60.0)	43.6 (32.8, 54.5)	66.0 (59.1, 72.8)	41.9 (31.9, 52.0)	30.9 (19.1, 42.6)
EMT–paramedic	53.7 (46.9, 60.4)	47.9 (41.2, 54.6)	37.7 (31.1, 44.3)	57.8 (51.7, 63.9)	43.1 (37.1, 49.1)	27.7 (23.8, 31.6)
Prehospital RN	73.2 (62.7, 83.8)	67.7 (56.8, 78.7)	71.7 (58.8, 84.5)	74.8 (61.5, 88.1)	53.5 (43.4, 63.6)	39.4 (24.2, 54.6)
Other	82.7 (72.0, 93.4)	77.3 (66.8, 87.9)	66.7 (53.9, 79.5)	84.0 (76.7, 91.3)	63.5 (52.4, 74.6)	34.7 (23.8, 45.5)
Full-time status	NS	NS	NS	NS	NS	NS
Career full-time	58.2 (52.0, 64.4)	52.1 (45.4, 58.7)	41.9 (34.7, 49.1)	62.9 (56.5, 69.3)	44.9 (39.1, 50.8)	27.8 (24.2, 31.5)
Part-time	60.8 (51.0, 70.6)	56.7 (47.2, 66.1)	52.0 (39.7, 64.4)	65.7 (56.2, 75.2)	50.6 (42.8, 58.4)	31.9 (25.4, 38.4)
Volunteer	71.4 (58.0, 84.8)	66.7 (40.8, 92.5)	53.6 (31.0, 76.1)	82.1 (68.8, 95.5)	64.3 (40.2, 88.4)	32.1 (8.6, 55.7)
Education	NS	NS	NS	NS	NS	*
Some high school, high school graduate, or GED	66.4 (54.5, 78.2)	57.1 (45.2, 69.1)	46.2 (35.1, 57.2)	64.7 (51.9, 77.5)	53.8 (42.4, 65.1)	21.8 (13.5, 30.2)
Some college	57.5 (51.1, 63.8)	51.6 (45.4, 57.9)	40.7 (34.0, 47.4)	61.3 (54.5, 68.0)	48.4 (43.0, 53.8)	25.4 (21.6, 29.2)
College (AD or bachelor's)	59.1 (52.4, 65.9)	53.4 (46.6, 60.3)	45.3 (37.3, 53.3)	65.4 (58.9, 71.9)	45.2 (39.6, 50.7)	31.7 (27.6, 35.7)
College (graduate)	56.9 (43.7, 70.1)	54.2 (38.3, 70.0)	52.8 (36.4, 69.2)	62.5 (49.2, 75.8)	35.2 (21.8, 48.6)	35.2 (19.9, 50.5)

*Indicates significant differences at the $p < 0.05$ level in the proportion of positive responses for a particular domain across different levels of a variable. †Indicates significance at $p < 0.0001$.

AD = associate's degree; EMS = emergency medical services; EMT = emergency medical technician; GED = general educational development; NS = no significant differences identified; RN = registered nurse.

Identifying medical errors and adverse events is a time-intensive exercise for which standards for identification and classification are limited.[10]

Conclusion

Workplace safety culture varies widely in this sample of EMS agencies. The EMS-SAQ can provide insights into prehospital safety.

References

1. Zohar D. Safety climate in industrial organizations: theoretical and applied implications. J Appl Psychol. 1980;65:96–102.
2. Joint Commission. Sentinel Event Alert. Issue 40: Behaviors That Undermine a Culture of Safety. 2008. Available at: http://www.jointcommission.org/SentinelEvents/Sentineleventalert/sea_40.htm. Accessed October 12, 2009.
3. Agency for Healthcare Research and Quality. Surveys on Patient Safety Culture. 2009. Available at: http://www.ahrq.gov/QUAL/patientsafetyculture. Accessed October 12, 2009.
4. Institute for Healthcare Improvement. Develop a Culture of Safety. 2009. Available at: http://www.ihi.org/IHI/Topics/PatientSafety/SafetyGeneral/Changes/Develop+a+Culture+of+Safety.htm. Accessed October 12, 2009.
5. Reinert A, Wingrove G. Rural Responder: Learning from Our Mistakes: How the Principles of Just Culture Can Lead to Greater Safety in EMS. EMSResponder.com. Available at: http://www.emsresponder.com/web/online/Rural-EMS-Resource-Guide/Rural-Responder–Learning-from-Our-Mistakes/49$9779. Published June 26, 2009. Accessed October 12, 2009.
6. Zohar D. A group-level model of safety climate: testing the effect of group climate on microaccidents in manufacturing jobs. J Appl Psychol. 2000;85:587–96.
7. Lee T. Assessment of safety culture at a nuclear reprocessing plant. Work Stress. 1998;12:217–237.
8. Pronovost PJ, Berenholtz SM, Goeschel CA, et al. Improving patient safety in intensive care units in Michigan. J Crit Care. 2008;23:207–221.
9. MacDonald RD, Banks BA, Morrison M. Epidemiology of adverse events in air medical transport. Acad Emerg Med. 2008;15:923–31.
10. Patterson PD, Martin-Gill C, Roth RN, et al. Identification of adverse events in ground emergency medical services by medical directors [abstract]. Prehosp Emerg Care. 2010;14(suppl 1):15–6.

11. Katz SH, Falk JL. Misplaced endotracheal tubes by paramedics in an urban emergency medical services system. Ann Emerg Med. 2001;37:32–7.
12. Dunford JV, Davis DP, Ochs M, Doney M, Hoyt DB. Incidence of transient hypoxia and pulse rate reactivity during paramedic rapid sequence intubation. Ann Emerg Med. 2003;42:721–8.
13. Wang HE, Lave JR, Sirio CA, Yealy DM. Paramedic intubation errors: isolated events or symptoms of larger problems? Health Aff (Millwood). 2006;25:501–9.
14. Wang HE, Weaver MD, Abo BN, Kaliappan R, Fairbanks RJ. Ambulance stretcher adverse events. Qual Saf Health Care. 2009;18:213–6.
15. Rittenberger JC, Beck PW, Paris PM. Errors of omission in the treatment of prehospital chest pain patients. Prehosp Emerg Care. 2005;9:2–7.
16. Ray AM, Kupas DF. Comparison of rural and urban ambulance crashes in Pennsylvania. Prehosp Emerg Care. 2007;11: 416–20.
17. Wang HE, Fairbanks RJ, Shah MN, Abo BN, Yealy DM. Tort claims and adverse events in emergency medical services. Ann Emerg Med. 2008;52:256–62.
18. Knox M. Emergency shortage: Low pay, stressful work keep would-be paramedics away. Concord, NC: Independent Tribune. October 8, 2006.
19. Patterson PD, Probst JC, Leith KH, Corwin SJ, Powell MP. Recruitment and retention of EMTs: a qualitative study. J Allied Health. 2005;34:153–62.
20. Boudreaux E, Mandry C, Brantley PJ. Stress, job satisfaction, coping, and psychological distress among emergency medical technicians. Prehosp Disaster Med. 1997;12:9–16.
21. Slattery DE, Silver A. The hazards of providing care in emergency vehicles: an opportunity for reform. Prehosp Emerg Care. 2009;13:388–97.
22. Atack L, Maher J. Emergency medical and health providers' perceptions of key issues in prehospital patient safety. Prehosp Emerg Care. 2010;14:95–102.
23. Patterson PD, Suffoletto BP, Kupas DF, Weaver MD, Hostler D. Sleep quality and fatigue among prehospital providers. Prehosp Emerg Care. 2010;14:187–93.
24. Patterson PD, Moore CG, Sanddal ND, Wingrove G, LaCroix B. Characterizing job satisfaction and intent to leave among nationally registered emergency medical technicians: an analysis of the 2005 LEADS survey. J Allied Health. 2009;38:e84–91.
25. West CP, Tan AD, Habermann TM, Sloan JA, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. JAMA. 2009;302:1294–300.
26. Chen I, Vorona R, Chiu R, Ware JC. A survey of subjective sleepiness and consequences in attending physicians. Behav Sleep Med. 2008;6:1–15.
27. Landrigan CP, Rothschild JM, Cronin JW, et al. Effect of reducing interns' work hours on serious medical errors in intensive care units. N Engl J Med. 2004;351:1838–48.
28. Lockley SW, Barger LK, Ayas NT, et al. Effects of health care provider work hours and sleep deprivation on safety and performance. Jt Comm J Qual Patient Saf. 2007;33(11 suppl):7–18.
29. Dorrian J, Tolley C, Lamond N, et al. Sleep and errors in a group of Australian hospital nurses at work and during the commute. Appl Ergon. 2008;39:605–13.
30. Sexton JB, Helmreich RL, Neilands TB, et al. The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research. BMC Health Serv Res. 2006;6:44.
31. Huang DT, Clermont G, Sexton JB, et al. Perceptions of safety culture vary across the intensive care units of a single institution. Crit Care Med. 2007;35:12.
32. Modak I, Sexton JB, Lux TR, Helmreich RL, Thomas EJ. Measuring safety culture in the ambulatory setting: the Safety Attitudes Questionnaire—ambulatory version. J Gen Intern Med. 2007;22:1–5.
33. Wisniewski AM, Erdley WS, Singh R, Servoss TJ, Naughton BJ, Singh G. Assessment of safety attitudes in a skilled nursing facility. Geriatr Nurs. 2007;28:126–36.
34. Patterson PD, Huang DT, Fairbanks RJ, Wang HE. The emergency medical services Safety Attitudes Questionnaire. Am J Med Qual. 2010;25:109–15.
35. Thomas EJ, Sexton JB, Helmreich RL. Discrepant attitudes about teamwork among critical care nurses and physicians. Crit Care Med. 2003;31:956–9.
36. Makary MA, Sexton JB, Freischlag JA, et al. Operating room teamwork among physicians and nurses: teamwork in the eye of the beholder. J Am Coll Surg. 2006;202:746–52.
37. Colla JB, Bracken AC, Kinney LM, Weeks WB. Measuring patient safety climate: a review of surveys. Qual Saf Health Care. 2005;14:364–6.
38. Waterson P, Griffiths P, Stride C, Murphy J, Hignet S. Psychometric properties of the hospital survey on patient safety culture: findings from the UK. Qual Saf Health Care. 2010. [Epub ahead of print]. PMID:20211960.
39. Nunnally J. Psychometric Theory. New York, NY: McGraw-Hill, 1978.
40. Hatcher L. A Step-by-Step Approach to Using the SAS System for Factor Analysis and Structural Equation Modeling. Cary, NC: SAS Institute Inc., 1994.
41. Anderson JC, Gerbing DW. Structural equation modeling in practice: a review and recommended two-step approach. Psychol Bull. 1988;103:411–23.
42. Marsh HW, Balla JR, McDonald RP. Goodness-of-fit indexes in confirmatory factor analysis: the effect of sample size. Psychol Bull. 1988;103:411–23.
43. Suyama J, Rittenberger JC, Patterson PD, Hostler D. Comparison of public safety provider injury rates. Prehosp Emerg Care. 2009;13:451–5.
44. Maguire BJ, Hunting KL, Guidotti TL, Smith GS. Occupational injuries among emergency medical services personnel. Prehosp Emerg Care. 2005;9:405–11.
45. Wang HE, Lave JR, Sirio CA, Yealy DM. Paramedic intubation errors: isolated events or symptoms of a larger problem? Health Aff (Millwood). 2006;25:501–9.
46. Freeman VA, Slifkin R, Patterson PD. Recruitment and retention in rural and urban EMS: results from a national survey of local EMS directors. J Public Health Manag Pract. 2009;15:246–52.
47. Chng CL, Eaddy S. Sensation seeking as it relates to burnout among emergency medical personnel: a Texas study. Prehosp Disaster Med. 1999;14:240–4.
48. Patterson PD, Suffoletto B, Hostler D, Kupas DF, Weaver M. Sleep quality and fatigue among prehospital providers [abstract]. Prehosp Emerg Care. 2009;13:141–2.
49. Yassi A, Hancock T. Patient safety—worker safety: building a culture of safety to improve healthcare worker and patient well-being. Healthc Q. 2005;8(Spec No):32–8.
50. Hobgood C, Bowen JB, Brice JH, Overby B, Tamayo-Sarver JH. Do EMS personnel identify, report, and disclose medical errors? Prehosp Emerg Care. 2006;10:21–7.
51. Institute of Medicine. To Err Is Human: Building a Safer Health System. Washington, DC: National Academies of Science, 2000.
52. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. J Clin Epidemiol. 1997;50:1129–36.
53. Weingart SN, Farbstein K, Davis RB, Phillips RS. Using a multihospital survey to examine the safety culture. Jt Comm J Qual Saf. 2004;30:125–32.
54. Singer SJ, Gaba DM, Geppert JJ, Sinaiko AD, Howard SK, Park KC. The culture of safety: results of an organization-wide survey in 15 California hospitals. Qual Saf Health Care. 2003;12:112–8.

55. Wagner LM, Capezuti E, Rice JC. Nurses' perceptions of safety culture in long-term care settings. J Nurs Scholarsh. 2009;41:184–92.
56. Pringle J, Weber RJ, Rice K, Kirisci L, Sirio C. Examination of how a survey can spur culture changes using a quality improvement approach: a region-wide approach to determining a patient safety culture. Am J Med Qual. 2009;24:374–84.
57. Pronovost PJ, Sexton JB. Assessing safety culture: guidelines and recommendations. Qual Saf Health Care. 2005;14: 231–233.

Appendix 1

Questions on the Emergency Medical Services Safety Attitudes Questionnaire (EMS-SAQ)

Respondents provided five-point Likert responses to each question.

(1 = disagree strongly, 2 = disagree slightly, 3 = neutral, 4 = agree slightly, 5 = agree strongly)

1. I like my job.
2. EMS personnel input is well-received in this EMS agency.
3. I would feel safe being treated by this EMS agency as a patient.
4. Medical errors are handled appropriately at this EMS agency.
5. This EMS agency does a good job of training new personnel.
6. Working at this EMS agency is like being part of a large family.
7. The management of this EMS agency supports my daily efforts.
8. I receive appropriate feedback about my performance.
9. In this EMS agency, it is difficult to discuss errors.
10. Staff turnover at this agency is high.
11. This EMS agency is a good place to work.
12. Management does not knowingly compromise the safety of patients.
13. The levels of staffing at this EMS agency are sufficient to handle the number of calls.
14. I am encouraged by my colleagues to report any patient safety concerns I may have.
15. The culture at this EMS agency makes it easy to learn from the errors of others.
16. This EMS agency deals constructively with problem personnel.
17. At this EMS agency, it is difficult to speak up if I perceive a problem with patient care.
18. When my workload becomes excessive, my performance is impaired.
19. I am provided with adequate, timely information about events that might affect my work.
20. Many EMS personnel at this agency have other full-time or part-time jobs.
21. I have seen others make errors that had the potential to harm patients.
22. I know the proper channels to direct questions regarding patient safety.
23. I am proud to work at this EMS agency.
24. Disagreements at this EMS agency are resolved appropriately (i.e., not who is right, but what is best for the patient).
25. I am less effective at work when fatigued.
26. I am more likely to make errors in tense or hostile situations.
27. I have the support I need from other personnel to care for patients.
28. It is easy for personnel at this EMS agency to ask questions when there is something they do not understand.
29. Personnel here work together as a well-coordinated team.
30. I have co-workers who are actively looking for additional full-time or part-time work.
31. Morale at this EMS agency is high.
32. Trainees in my discipline are adequately supervised.
33. I have made errors that had the potential to harm patients.
34. Fatigue impairs my performance during emergency situations.
35. During emergency situations (i.e., cardiac arrests, traumas, etc.), my performance is not affected by working with inexperienced or less capable personnel.
36. Personnel frequently disregard rules or guidelines (i.e., treatment protocols, standard operating procedures, etc.) that are established for this EMS agency.
37. A confidential reporting system is helpful for improving patient safety.
38. I may hesitate to use a reporting system because I am concerned about being identified.
39. This agency provides me with the training to prevent ambulance driving accidents.
40. I have co-workers who are actively looking to leave this agency for other employment.
41. This agency could do more to improve emergency vehicle driver safety.
42. When moving a patient, I have the training to prevent injury to the patient.
43. When moving a patient, I have the right equipment to prevent injury to the patient.
44. All the necessary information for treating patients is routinely available to me.
45. Patient safety is constantly reinforced as the priority in this EMS agency.
46. Emergency vehicle or aircraft accidents occur at this EMS agency.
47. Emergency vehicle or aircraft accident close-calls (near-misses) occur at this EMS agency.

48. Patient handling mishaps (i.e., stretcher collapse, patient drop or fall, etc.) occur at this EMS agency.
49. Medical adverse events (i.e., incidents where a patient was harmed from medical care or medical equipment malfunction) occur at this EMS agency.
50. Medical adverse event close-calls (near-misses) occur at this EMS agency.

APPENDIX 2

Calculation of the Mean Domain Score

1. Questions (or items) are grouped by domain
   a. Safety Climate domain (Questions: 3, 4, 8, 9, 14, 15, 22)
   b. Teamwork Climate domain (Questions: 2, 17, 24, 27, 28, 29)
   c. Stress Recognition domain (Questions: 18, 25, 26, 34)
   d. Perceptions of Management domain (Questions: 7, 12, 13, 19)
   e. Working Conditions domain (Questions: 5, 16, 32, 44)
   f. Job Satisfaction domain (Questions: 1, 6, 11, 23, 31)
2. Questions 9 and 17 are reverse coded to match the positive valence of the other questions.
3. The Likert scale responses are coded to a 100-point scale.
   a. Disagree Strongly = 0
   b. Disagree Slightly = 25
   c. Neutral = 50
   d. Agree Slightly = 75
   e. Agree Strongly = 100
4. Scores for each question/item are totaled and divided by the total number of questions/items within each domain.

Calculation of the Percentage of Positive Responses (PPR) Scores

The percentage of positive responses (PPR) is the proportion of respondents who have a positive perception of a domain.[30]

1. For each individual respondent, we identified positive (score $\geq$75) and nonpositive (score <75) responses for each domain. For example, if a respondent's average score for the four items that measure the Stress Recognition domain was 72, that respondent would be classified as a "nonpositive response." If a respondent's average Stress Recognition score was 82, that respondent would be classified as a "positive response." To be considered positive, a respondent would need to record an "agree slightly" or higher for each of the items within a given domain.
2. We identified the proportion of respondents with a positive perception for each domain.