Research

Evaluating safety culture changes over time with the Emergency Medical Services Safety Attitudes Questionnaire

Yuval Bitan PhD is Senior Lecturer¹ and Assistant Professor²; Philip Moran Phil MD, MPH, FRCPC, FACEP is Medical Director³ and Assistant Professor⁴; James Harris BA was Lab Instructor and Professor for Medical Legal Issues for paramedics³

Affiliations:

¹Department of Industrial Engineering & Management, Ben-Gurion University of the Negev, Be'er-Sheva, Israel

²Department of Mechanical & Industrial Engineering, University of Toronto, Canada

³Central East Prehospital Care Program, Lakeridge Health Corporation, Ontario, Canada

⁴Department of Medicine, University of Toronto

<https://doi.org/10.33151/ajp.16.628>

Abstract

Introduction

The correlation between patient outcomes and the safety culture in healthcare organisations draws special attention to tools that can measure safety culture in such organisations. One of the advantages of such tools is their ability to identify changes in safety climate, which can support healthcare organisations in detecting and understanding trends, which might have otherwise been overlooked.

Objective

To evaluate the ability of a standard survey to capture long-term safety climate changes in pre-hospital care.

Methods

The previously validated Emergency Medical Services Safety Attitudes Questionnaire was administered in one regional base hospital program, which delegates to six pre-hospital emergency care services. The survey was administered over two consecutive years, thus allowing us to measure safety climate changes over time.

Results

Significant differences were found between the first and second years of the survey in specific services.

Conclusion

While we cannot identify the specific causes for the change in scores in the various services between the two survey years, we can draw some inferences. We suggest that the small changes that tend to reflect a consistent change across all services are the result of training and educational initiatives, while greater changes in some of the services reflect a change in the attitude of the paramedics to the service, driven by changes in operational procedures within the service. Our findings demonstrate that the questionnaire can capture safety climate changes over time in pre-hospital emergency care.

Keywords:

safety culture; paramedic services; EMS; EMS-SAQ; pre-hospital; paramedicine

Corresponding Author: Yuval Bitan, Yuval@Bitan.net

Introduction

The unique characteristics of pre-hospital emergency care

Pre-hospital emergency care – also known as emergency medical services (EMS), paramedicine or paramedic services – are essential for public safety and for the functioning of the healthcare system. The work environment of paramedics is unique even among other healthcare systems (which generally tend to be highly dynamic) (1), as they are often the first point of clinical contact between the patient, who may be in extreme need of immediate medical attention, and the healthcare system. As such, paramedics must assess and diagnose the condition of the patient quickly and efficiently, to deliver high level interventions in difficult circumstances in places not designed for healthcare procedures (2,3).

Despite the critical role of pre-hospital emergency care, these services are often a neglected component of the healthcare system. Indeed, pre-hospital emergency care is relatively new as a separate discipline and many of its devices, procedures and settings are based on practices inherited from hospital settings and are similar to those used in emergency departments and intensive care units. Notably however, many of these inherited in-hospital practices are inadequate for use in the unique work environment of paramedical care, and this incongruity may ultimately affect the health and safety of both the paramedics and their patients.

The working environment in pre-hospital emergency care is fast-paced, physically dangerous and highly stressful, requiring quick decision-making and action. Interventions performed by paramedics often involve procedures that, if performed incorrectly or at the wrong time, can cause serious harm to patients. In this high-risk environment, system failure can happen and safety-related incidents, such as non-compliance with treatment protocols, medication errors or failed communication, have been documented in the literature (4-6).

Other unique characteristics of pre-hospital emergency care are that these services are smaller than other healthcare organisation services, they comprise only a few professional groups, their professional work is always performed in small teams (usually not more than two to three paramedics per patient), and there is a defined hierarchy within these teams (7). These characteristics generate a work environment in which personnel play a major role; therefore, special attention to the organisational culture of pre-hospital emergency care is required.

Patient safety and the organisational safety culture

The understanding that, despite the promise to 'do no harm', adverse events happen and patients' lives might be in danger was identified in the 1980s (8-10). Research in other complex and high-risk working environments, such as nuclear power plants or aviation-related workplaces, has linked the organisational safety culture to accidents and safety behaviour.

However, although the organisational safety culture is a major predictor of safety outcomes, (11) only a few studies have characterised the safety culture in pre-hospital emergency care (12).

Previous research linked safety culture scores in healthcare organisations to safety indicators (13) and to changes in patient outcomes (14). In addition, the association between paramedics' interventions, their safety culture and patient outcomes has been demonstrated (15). Thus, we argue that a safety culture survey can help in capturing the beliefs and perceptions of paramedics regarding the organisation and safety of their workplace, and how these change over time. To test this hypothesis we employed a version of the Safety Attitudes Questionnaire (SAQ) as a measuring tool for patient safety culture in pre-hospital emergency care organisations.

The SAQ is a survey instrument that measures six dimensions of the safety culture in the workplace, namely, its safety climate, teamwork climate, perceptions of management, job satisfaction, working conditions and stress recognition. While the SAQ is based on the Flight Management Attitudes Questionnaire (16) which assesses the safety culture in airline cockpits, it was later migrated to measure healthcare work environments. This adapted version has been validated in a wide range of medical settings, including ambulatory care, operating rooms, intensive care units and skilled nursing facilities (16,17). This version was later modified for paramedic-related settings in the United States, known as the Emergency Medical Services Safety Attitudes Questionnaire (EMS-SAQ) (18).

As a validated safety culture survey, the SAQ can serve as a standard measurement tool to compare safety culture levels across organisations. However, the tool can also serve to measure the safety culture level within an organisation. Thus, even if language and culture differences may affect the validity of the survey when comparing safety levels across jurisdictions, the SAQ can be highly beneficial for monitoring changes in safety culture within one jurisdiction. After administering the survey for the first time (ie. to generate a baseline of the attitude, beliefs and culture in the organisation), the SAQ can be re-applied to evaluate changes in the safety culture over time.

In this current study, we adapted and modified the EMS-SAQ for the structure of pre-hospital emergency care services in Ontario, Canada. We sought to characterise variation in safety culture in one regional base hospital program, which delegates to six pre-hospital emergency care services. Our modified version of the EMS-SAQ allowed us to determine variations in safety culture between services, over time. We expected that training and education would influence all services in a similar manner, while significant differences in EMS-SAQ scores within a service would suggest a change in the attitude of paramedics to the service and its management, resulting in changes to the safety culture in the organisation.

Method

The regional base hospital program in Ontario, Canada, provides annual training sessions and certification to all paramedics in the region. We collaborated with one of the regional base hospital programs to adopt a safety culture survey, which would be applicable to pre-hospital emergency care in Ontario. As we administered the survey over two consecutive years, we were able to measure the changes in safety culture over this period. Information about the services in the region and the population that they serve is detailed in Table 1.

We administered the EMS-SAQ over two consecutive years (2014 and 2015) and in six pre-hospital emergency care services, which operate under one regional base hospital program in Ontario, Canada. While the medical directive for all six services was under the same regional base hospital program, the operational management was local and each service was under the authority of a different paramedic chief. The subjects in the 2014 survey were 1035 paramedics from the six services, while the subjects in the 2015 survey were 1047 paramedics from the same six services. Table 1 details the participation of the paramedics in the two annual training sessions (note that the number of active paramedics might fluctuate during the year). In each of the two years, the survey was administered on the last day of an annual training session that all paramedics in the regional base hospital program were required to take. The survey was anonymised and the paramedics could choose not to participate. The study was approved for the regional base hospital program by the research ethics board of the host hospital.

As mentioned, we based our safety culture survey on the EMS-SAQ, which was developed by Patterson et al (18,19). Since the original survey was developed in the US, where EMS organisations have a different structure than those in Ontario, minor modifications to some of the questions were required. These modifications did not change the meaning of the questions, but only customised the wording to a

terminology that better fits the Ontario system. For example, because the Ontario EMS structure separates the medical directive from the operational management, and because the services are also under the authority of the provincial Ministry of Health and Long-Term Care, we changed references to 'EMS agency' in the original EMS-SAQ to 'EMS system' in our version. Our survey comprised 43 questions (rather than 50 in the original EMS-SAQ) and, like the original EMS-SAQ survey, it characterised six safety domains: 1) safety climate, 2) job satisfaction, 3) perceptions of management, 4) teamwork climate, 5) working conditions, and 6) stress recognition. Like in the original EMS-SAQ survey, participants were requested to select one statement that best represents their feelings regarding each question on a 5-point Likert scale (strongly disagree; disagree; neutral; agree; strongly agree).

Our data analysis followed the method described in Patterson et al. We report the results of the percentage of positive responses (PPR) scores, grouped by service, which are calculated as the proportion of respondents who have a positive perception of a domain (16). Statistical analysis was conducted with IBM-SPSS (version 21) in two steps: first, we evaluated the year-to-year changes in each domain by using a two-way ANOVA with Year and Service as the independent between-subject variables; second, since the interaction between Year and Service was significant, we followed this comparison with a two-sample t-test to compare between years within each service. The results are reported after correction for multiple comparisons (six services).

Results

The PPR scores obtained in the two survey years are presented in Table 2. The 2014 survey revealed that two services (#3 and #4) scored highest in all safety domains, except in the stress recognition domain, in which services #1 and #6 scored highest. There were no consistent 'leaders' in the 2015 survey, but the results indicate that service #1 scored lowest in all safety domains, except in the stress recognition domain, in which it was scored the highest after service #6.

Table 1. Information about the six services and their participation in the 2014 and 2015 EMS-SAQ surveys

Service #	Population served by each service (rounded as of 2011*)	Average ambulance calls per year	Number of paramedics in the service	Paramedics participating in the 2014 survey	Paramedics participating in the 2015 survey	Paramedics participating in the two surveys (average)
1	610,000	60,000	348	310	312	89%
2	17,000	2500	56	36	41	69%
3	73,000	9000	87	57	54	64%
4	82,000	9000	119	88	75	68%
5	135,000	16,000	148	99	105	69%
6	1,000,000	80,000	521	445	460	87%

* Population information as reported by the Ontario province

Table 2. PPR scores (SD in parentheses) in the 2014 and 2015 EMS-SAQ surveys, grouped by service and domain

Domain	Safety climate		Teamwork climate		Stress recognition		Perceptions of management		Working conditions		Job satisfaction	
*Service #	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1	9% (29%)	24% (43%)	5% (22%)	11% (31%)	49% (50%)	52% (50%)	15% (36%)	14% (35%)	8% (27%)	9% (29%)	39% (49%)	53% (50%)
2	23% (43%)	37% (49%)	18% (39%)	29% (46%)	28% (46%)	41% (50%)	41% (50%)	34% (48%)	21% (41%)	12% (33%)	62% (49%)	59% (50%)
3	38% (49%)	33% (47%)	38% (49%)	20% (40%)	33% (48%)	35% (48%)	51% (51%)	31% (47%)	22% (42%)	22% (42%)	84% (37%)	58% (50%)
4	38% (49%)	33% (47%)	49% (50%)	34% (48%)	38% (49%)	37% (49%)	68% (47%)	38% (49%)	30% (46%)	28% (45%)	83% (38%)	72% (45%)
5	18% (39%)	29% (46%)	13% (33%)	17% (38%)	35% (48%)	46% (50%)	38% (49%)	31% (47%)	16% (36%)	17% (38%)	57% (50%)	61% (49%)
6	27% (45%)	27% (44%)	23% (42%)	25% (43%)	53% (50%)	59% (49%)	38% (49%)	31% (46%)	21% (41%)	23% (42%)	67% (47%)	67% (47%)

* The number of valid responses: 904 in the 2014 survey; 1072 in the 2015 survey

Figure 1. Changes in the EMS-SAQ scores of the six services between 2014 and 2015

Next, we compared the year-to-year scores within each service to identify time-related changes. This analysis revealed that the scores of services #1, #2 and #5 mainly increased, whereas those of services #3 and #4 mainly decreased from 2014 to 2015. Service #6 showed only small changes between the two years (Figure 1).

The statistical analyses indicated a significant interaction between Year and Service in four safety domains: safety climate [$F(5,1926) = 3.242, p=0.006$], teamwork climate

[$F(5,1927) = 3.15, p=0.008$], perception of management [$F(5,1927) = 2.59, p=0.024$], and job satisfaction [$F(5,1927) = 4.28, p=0.001$]. Pairwise comparisons between years within each service revealed significant differences between years in some services but not in others. Specifically, the scores of service #1 significantly increased ($p=0.000$) between 2014 and 2015 in two domains: safety climate and job satisfaction. This service also demonstrated an increase in the scores of the teamwork climate domain, but this increase was significant only with the non-corrected p-value ($p=0.01$).

The scores of services #3 and #4 decreased between 2014 and 2015 in four domains: safety climate, teamwork climate, perceptions of management and job satisfaction. Two of these changes were significant [namely, service #3 in the job satisfaction domain ($p=0.003$) and service #4 in the perceptions of management domain ($p=0.001$)], while the change in the two other domains was significant only with the non-corrected p -value [service #3 in the teamwork climate domain ($p=0.054$) and in the perceptions of management domain ($p=0.042$)].

Discussion

Our analyses demonstrate that the EMS-SAQ survey can identify both small and large changes in organisational safety culture. These statistically significant changes can be identified per domain, either on an individual service level or on a program level. We believe that the small changes, which tend to reflect a consistent change across all services between the two years, are the result of training and educational initiatives, such as a safety educational package – a self-guided training tool on safety culture and just culture – that was administered to all paramedics during the interval between the two survey years. These interventions were initiated by the base hospital and were implemented across the services in the program, and reflect continuous effort to improve safety culture across the program. Similarly, we believe that the large changes observed in specific services reflect a change in the attitude of the paramedics to the service. Although we cannot identify the specific causes for such large changes, eg. for the decrease in the scores of services #3 and #4 between the two years or for the increase in the score in several safety domains of service #1, we speculate that these changes are driven by changes in operational procedures within the service, and conflicts between the paramedics and the service management team. As previous studies demonstrated the important effects of leadership and management on safety culture (20), we assume that some management changes and the interaction between the management and the paramedics in these services between the two survey years were reflected in the changes that we observed in the organisational safety climate. As expected, these changes can affect safety culture in both directions – it can generate an environment with improved safety culture, or it can degrade the attitude toward safety in the organisation.

Conclusions

Our study demonstrates how pre-hospital emergency care services can apply the EMS-SAQ survey as a monitoring tool for changes in personnel attitude to the service over time. The EMS-SAQ can serve as a valuable tool to reliably measure and evaluate the safety climate in pre-hospital emergency care, and it is sufficiently sensitive to capture changes within these services, over time. Although we do not currently have the tools to explain the reasons underlying such changes in the safety climate, we believe that it is important to notice

them. Pre-hospital emergency care services can thus apply the EMS-SAQ as a tool for monitoring changes in the attitudes of their personnel and for indicating specific safety domains that require intervention and focus.

Limitations

It is hard to determine the specific causes that resulted in the time-dependent change in survey scores, as three levels of administration may have affected the scores: The Ministry of Health and Long-Term Care, the regional base hospital program and the service. While we are aware of changes in the management in service #4 and of a major disagreement regarding staffing and labour issues between the paramedics and the management in service #3, it is hard to identify the reasons that contributed to the change in the safety climate within individual services over the course of a year.

Acknowledgements

This study was partially supported by the Lakeridge Health Corporation (ON, Canada). It was conducted while the first author was a visiting researcher at HumanEra at the University Health Network (ON, Canada). The two other authors were employees of the Lakeridge Health Corporation. Parts of the study were presented in the National Association of EMS Physicians 2016 Annual Meeting at San Diego, CA.

Conflict of interest

The authors declare no competing interests. Each author of this paper has completed the ICMJE conflict of interest statement.

References

1. Cook R, Woods D. Operating at the sharp end : the human factors of complex technical work and its implications the current interest in human factors. Bogner M-S, editor. Human Error in Medicine. Hillsdale, NJ; 1994, p. 225-310.
2. Griffiths P, Mooney GP. Research and the paramedic. Griffiths P, Mooney G, editors. The paramedic's guide to research: an introduction. Open University Press; 2011, p. 1-10.
3. Jensen JL, Croskerry P, Travers AH. Consensus on paramedic clinical decisions during high-acuity emergency calls: results of a Canadian Delphi study. Can J Emerg Med 2011;13:310-8.
4. Hoyle JD, Davis AT, Putman KK, Trytko J, Fales WD. Medication dosing errors in pediatric patients treated by emergency medical services. Prehosp Emerg Care 2012;16:59-66.
5. Vilke GM, Tornabene SV, Stepanski B, et al. Paramedic self-reported medication errors. Prehosp Emerg Care 2007;11:80-4. Available at: <http://informahealthcare.com/doi/abs/10.1080/10903120601021358>

References (continued)

6. Kupas DF, Shayhorn M, Green P, Payton TF. Structured Inspection of medications carried and stored by emergency medical services agencies identifies practices that may lead to medication errors. *ibid.* 2012;16:67-75.
7. Bitan Y. Changes from within – how paramedic services can lead the way human factors is implemented in healthcare. In: Keebler J, Lazzara E, Misasi P, editors. *Ergonomics and Human Factors of Prehospital Emergency Care*. Taylor & Francis Group, LLC; 2017, p. 165-76.
8. Leape LL, Brennan TA, Laird NAN, et al. The nature of adverse events in hospitalized patients: results of the Harvard Medical Practice Study II. *N Engl J Med* 1991;324:377-84.
9. Cook R, Woods D. Operating at the sharp end: the complexity of human error. In: Bogner S, editor. *Human Error in Medicine*. CRC Press; 1994, p. 255-310.
10. Schreiber M, Klingelhöfer D, Groneberg DA, Brüggmann D. Patient safety: the landscape of the global research output and gender distribution. *BMJ Open* 2016;6:e008322. Available at: www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4762108&tool=pmcentrez&rendertype=abstract
11. Zohar D. Thirty years of safety climate research: reflections and future directions. *Accid Anal Prev* 2010;42:1517-22.
12. Bigham BL, Buick JE, Brooks SC, et al. Patient Safety in emergency medical services: a systematic review of the literature. *Prehospital Emerg Care* 2012;16:20-35.
13. Singer S, Lin S, Falwell A, Gaba D, Baker L. Relationship of safety climate and safety performance in hospitals. *Health Serv Res* 2009;44:399-421.
14. Rosen AK, Singer S, Shibe Z, et al. Hospital safety climate and safety outcomes: is there a relationship in the VA? *Med Care Res Rev* 2010;67:590-608. Available at: www.ncbi.nlm.nih.gov/pubmed/20139397
15. Weaver MD, Wang HE, Fairbanks RJ, Patterson D. The association between EMS workplace safety culture and safety outcomes. *Prehospital Emerg Care* 2012;16:43-52.
16. 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.
17. 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;35:165-76.
18. Patterson PD, Huang DT, Fairbanks RJ, et al. Variation in emergency medical services workplace safety culture. *Prehosp Emerg Care* 2010;14:448-60.
19. Patterson PD, Huang DT, Fairbanks RJ, Wang HE. The emergency medical services safety attitudes questionnaire. *Am J Med Qual* 2010;25:109-15.
20. Zohar D. The effects of leadership dimensions, safety climate, and assigned priorities on minor injuries in work groups. *J Organ Behav* 2002;23:75-92. Available at: <http://doi.wiley.com/10.1002/job.130>