



ORIGINAL ARTICLE

Cross-cultural adaptation of the SCORE survey and evaluation of the impact of Real-Time Random Safety Audits in organizational culture: A multicenter study



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KEYWORDS

Intensive care medicine;
Organizational change;
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Abstract

Objective: To establish a cross-cultural adaptation of the Safety, Communication, Operational Reliability, and Engagement (SCORE) survey and to use this instrument to evaluate the impact of a safety intervention.

Design: Cross-cultural adaptation and before-and-after evaluation study.

Setting: 5 ICU.

Participants: Medical residents, attending physicians, and nurses at those ICU.

Interventions: Adaptation of the SCORE survey to Spanish culture. The adapted survey was used to assess all safety-culture-related domains before and one-year after implementing the use of a safety tool, Real-Time Random Safety Audits (in Spanish: Análisis Aleatorios de Seguridad en Tiempo Real, AASTRE).

Main outcome measure: Adaptability of the Spanish version of SCORE survey in the ICU setting and evaluation of the effect of AASTRE on their domains.

Results: The cross-cultural adaptation was adequate. Post-AASTRE survey scores [mean (standard deviation, SD)] were significantly better in the domains learning environment [50.55 (SD 20.62) vs 60.76 (SD 23.66), $p < .0001$], perception of local leadership [47.98 (SD 23.57) vs 62.82 (SD 27.46), $p < .0001$], teamwork climate [51.19 (SD 18.55) vs 55.89 (SD 20.25), $p = .031$], safety climate [45.07 (SD 17.60) vs 50.36 (SD 19.65), $p = .01$], participation decision making

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t [3 (SD 0.82) vs 3.65 (SD 0.87), $p < .0001$] and advancement in the organization [3.21 (SD 0.77) vs 4.04 (SD 0.77), $p < .0001$]. However, post-AASTRE scores were significantly worse in the domains workload and burnout climate.

Conclusions: The cross-cultural adaptation of the SCORE survey into Spanish is a useful tool for ICUs. The application of the AASTRE is associated with improvements in six SCORE domains, including the safety climate.

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PALABRAS CLAVE

Medicina intensiva;
Cambio organizacional;
Encuesta de seguridad

Adaptación transcultural de la encuesta SCORE y evaluación del impacto de los análisis aleatorios de seguridad en tiempo real en la cultura organizacional: estudio multicéntrico

Resumen

Objetivo: Establecer una adaptación transcultural de la encuesta SCORE (Safety, Communication, Operational Reliability, and Engagement) y utilizar este instrumento para evaluar el impacto de una intervención en seguridad.

Diseño: Adaptación transcultural y análisis pre/post de la encuesta después de la intervención.
Entorno: Cinco UCI.

Participantes: Médicos residentes, médicos adjuntos y enfermeras.

Intervenciones: Adaptación de la encuesta SCORE al castellano. La encuesta adaptada se utilizó para medir el efecto en la organización (antes y un año después) de la utilización de una herramienta de seguridad, los análisis aleatorios de seguridad en tiempo real (AASTRE).

Medidas principales: La adaptabilidad de la versión española en el entorno de la UCI y la evaluación del efecto AASTRE en sus dominios.

Resultados: La adaptación intercultural fue adecuada. Las puntuaciones medias postintervención fueron mejores en los dominios, media (desviación estándar [DE]): entorno de aprendizaje (50,55 [DE 20,62] vs. 60,76 [DE 23,66], $p < 0,0001$), percepción del liderazgo (47,98 [DE 23,57] vs. 62,82 [DE 27,46], $p < 0,0001$), clima de trabajo en equipo (51,19 [DE 18,55] vs. 55,89 [DE 20,25], $p = 0,031$), clima de seguridad (45,07 [DE 17,60] vs. 50,36 [DE 19,65]), participación en toma de decisiones (3 [DE 0,82] vs. 3,65 [DE 0,87], $p < 0,0001$) y crecimiento dentro de la organización (3,21 [DE 0,77] vs. 4,04 [DE 0,77], $p < 0,0001$). En postintervención fueron peores los dominios: carga de trabajo y clima de burnout.

Conclusiones: La adaptación transcultural de la encuesta SCORE es un instrumento útil. La aplicación del AASTRE se asocia con mejoras en 6 dominios del SCORE, incluido el clima de seguridad.

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Introduction

Worrisome data has emerged regarding the psychosocial wellbeing of health professionals.¹ Various factors contribute to psychosocial dissatisfaction among healthcare professionals. Increasingly complex healthcare environments due to population aging, increased comorbidities, more demanding workflow, and constant upgrading of services result in unsustainable workloads.^{2,3} Moreover, healthcare workers commonly believe that they have insufficient resources to meet clinical demands.⁴ Consequently, many develop burnout syndrome, which worsens their quality of life and can even put their patients at risk.^{5,6}

On the other hand, health organizations promote non punitive environments, increasing psychological safety, that improves communication and knowledge sharing.⁷

In recent years, interest in assessing the impact of organizational aspects on healthcare professionals' wellbeing has grown. The Safety Attitude Questionnaire (SAQ),⁸ adapted to Spanish culture in 2010,⁹ explores 6 dimensions: teamwork climate, safety climate, job satisfaction, stress recognition, perceptions of management, and working conditions. However, the healthcare system has changed significantly since the questionnaire was developed, and it is necessary to include other domains. As a result, the Safety, Communication, Operational Reliability, and Engagement work survey (SCORE)¹⁰ was designed and validated in different clinical settings.^{11,12}

Our team recently developed a proactive safety tool called Real-Time Random Safety Audits (AASTRE) that minimizes errors, especially errors of omission, in clinical practice.^{13,14} Moreover, AASTRE have led to significant improvements in structural indicators, such as safety

Table 1 Characteristics of the participating intensive care units.

	University Hospital Joan XXIII	University Hospital Torrejón	University Hospital Henares	University Hospital Rio Hortega	University Hospital Mutua de Terrassa
Number of hospital beds	350	250	300	650	376
Number of ICU beds	14	16	9	19	12
Nurse/patient ratio	1:2	1:3	1:2	1:2	1:2
Physician/patient ratio	1:3–4	1:3–4	1:4–5	1:2–3	1:3–4
Medical students	Yes	Yes	Yes	Yes	Yes
Residents	Yes	No	Yes	Yes	Yes
Previous experience with AASTRE	Yes	Yes	No	Yes	No

climate.¹⁵ Considering this data, our hypothesis is that the AASTRE tool can improve some of the dimensions analyzed by the SCORE survey.

This study had two objectives: to adapt the SCORE survey to Spanish culture and to evaluate the impact of AASTRE on all the domains covered in the survey.

Patients and methods

Setting and subjects

Senior medical residents, attending physicians, and nurses at five intensive care units (ICU) in university hospitals, four of which were teaching both medical students and residents (Table 1). The clinical research ethics committee at each center approved the study.

SCORE survey

Comprises 73 questions that measure 12 domains: (1) preparation for improvement (learning environment), (2) local leadership, (3) burnout climate, (4) personal exhaustion (burnout), (5) teamwork climate, (6) safety climate, (7) opportunities for professional growth, (8) workload, (9) participation in decision-making, (10) advancement in the organization, (11) work-life balance, and (12) use of safety rounds. The psychometric characteristics of this survey are defined elsewhere [10].¹⁰ The questions in the survey explore both positive and negative aspects of the healthcare environment. Subjects respond on a five-point Likert scale ranging from A (totally disagree) to E (totally agree). Unlike in other domains, high scores in burnout climate, personal burnout, and workload are associated with undesirable outcomes. The survey concludes with a section that focuses on collecting sociodemographic and work-related data.

Cross-cultural adaptation

The SCORE survey was adapted to Spanish culture in four steps: (1) two experienced biomedical translators translated the original version into Spanish [9]⁹; (2) the research team evaluated the conceptual, grammatical, linguistic, and semantic equivalence of the translation; (3) a different biomedical translator translated the text back into English; and (4) the researchers assessed the acceptability of the Spanish version. To evaluate internal consistency, we used Cronbach's alpha coefficient, considering values ≥ 0.7 acceptable.¹⁶

Survey execution

Morning-shift healthcare workers from the 5 participating ICUs were invited to complete the SCORE survey on two occasions: in January 2018 (pre-AASTRE survey) and in January 2019 (post-AASTRE survey). No incentives were offered. During post-AASTRE survey, participants were asked about AASTRE rounds feedback.

Study design and description of AASTRE

AASTRE are a validated¹⁷ tool, that in this new version, check 32 mandatory safety measures, distributed in eight blocks: (1) mechanical ventilation, (2) hemodynamics, (3) renal function and continuous renal replacement techniques, (4) analgesia and sedation, (5) treatment, (6) nutrition, (7) nursing care and structure, and (8) clinical information system. Each safety measure has a specific definition, assessment criteria and a specific methodology for verification. Safety measures are listed in Table 2.

AASTRE were carried out twice a week for a total of 12 months. On evaluation days, 30% of the patients in the ICU and 50% of the safety-measure blocks were randomly selected. The possible responses during the audits are: (1) "Yes"—when the measure analyzed had been taken/performed on the ICU daily round; (2) "Yes, after

Table 2 Safety measures.

Block	Measures
1. Mechanical ventilation	1. Limits of alveolar pressure. 2. Mechanical ventilation alarms. 3. Tolerance of spontaneous ventilation. 4. Adequate tidal volumen.
2. Hemodynamics	5. Monitor alarms. 6. Administration of fluids in the initial phase of shock. 7. Administration of fluids in the stable phase of shock. 8. Adequate hemodynamics monitoring.
3. Renal function and continuous renal replacement techniques	9. Assessment of acute renal failure. 10. Prescription and monitoring of renal therapy.
4. Analgesia and sedation	11. Pain control. 12. Control of agitation and prevention of excessive sedation. 13. Prevention and management of delirium.
5. Treatment	14. Verification of allergies and drug intolerance in clinical history. 15. Correct prescription of daily orders of therapy. 16. Adequate indication and dose of prescribed medication. 17. Prescribed medication adequately administered. Verbal orders. 18. Prevention of thromboembolic disease. 19. Control of hyperglycemia. 20. Assessment of antibiotic therapy.
6. Nutrition	21. Monitoring of enteral nutrition. 22. Monitoring of parenteral nutrition.
7. Nursing care and structure	23. Oral hygiene with clorhexidine (0.12–0.2%). 24. Daily assessment of risk of developing pressure ulcers. 25. Semi-recumbent posture. 26. Daily assessment of the need for catheters. 27. Updated life-support therapy chart.
8. Clinical information system	28. Validation of the information provided by the devices. 29. Clinical information adequately. 30. Structured in the clinical history Integration of the hospital's clinical information sources.

AASTRE''—when the safety audit was used to detect an error of omission that has been corrected; (3) ''No''—when the measure analyzed could not be changed despite the audit; (4) ''Not applicable''—when the patient did not meet the assessment criteria. The checklist and the responses of the evaluations are entered into a web platform (<http://www.aastre.es>). A senior professional that was not directly responsible for any of the selected patients' care on evaluation day carried out the AASTRE, acting as the prompter and providing professionals with feedback during the interchange.

The proportion of changes in the care process carried out as a result of verification was considered. IPR-AASTRE (improvement proportion related to the AASTRE) were calculated globally (IPR-AASTRE-G) and for each block of variables (IPR-AASTRE-B), according to the following formulas:

$IPR-AASTRE = (\text{number of occasions on which the AASTRE changed clinical practice: "yes, after the AASTRE"}) / (\text{number of occasions on which the measure was}$

$\text{selected} - \text{number of occasions on which the measure was not applicable}) \times 100.$

Table 3 Internal consistency for each domain of the SCORE survey.

Domain	Cronbach's alpha
1. Learning environment	0.779
2. Local leadership	0.751
3. Burnout climate	0.779
4. Burnout	0.805
5. Teamwork climate	0.886
6. Security climate	0.825
7. Professional growth opportunities	0.853
8. Workload	0.826
9. Participation in decision-making	0.784
10. Advancement in the organization	0.721
11. Work-life balance	0.843

Statistical analysis

Categorical variables are reported as frequencies and percentages, and continuous variables as medians and ranges. To compare SCORE results between groups, we used the Mann–Whitney *U*. Statistical significance was set at $p \leq 0.05$. All analyses were done with IBM SPSS Statistics for Windows, version 19 (IBM Corp., Armonk, NY, USA).

Results

Cross-cultural adaptation

The Spanish version of the SCORE survey covers 12 domains (Supplementary Material A). Since Patient Safety Leadership WalkRounds were not performed in any participating hospital, this domain was eliminated from the analysis. Internal consistency was considered acceptable for all domains (Table 3). Researchers did not differ in their assessments of the acceptability the conceptual, grammatical, linguistic, and semantic equivalence of the translated items. Moreover, the translation of the Spanish version back into English was deemed equivalent to the original. Finally, the research team confirmed the feasibility and usability of the Spanish version.

Response rate and participants' demographics

The response rate was 72.5% for the pre-AASTRE evaluation and 63.2% for the post-AASTRE evaluation. The professionals analyzed were not nominally the same in the pre and post period. The highest response rates corresponded to the largest group, nurses (pre-AASTRE evaluation $n=91$, 56.5%; post-AASTRE $n=79$, 50%, respectively). Due to scant participation of nurses' aides, this subgroup was eliminated. In terms of working experience, healthcare professionals with 11–20 years' experience had the highest response rate (pre-AASTRE evaluation $n=49$, 31%; post-AASTRE $n=53$, 34.9%).

Table 4 Improvement proportion related to each blocks of safety measures (IPR-AASTRE-B).

Block	IPR-AASTRE-B (%)
Mechanical ventilation	12.71
Hemodynamics	4.96
Renal function and continuous renal replacement techniques	4.55
Sedation and analgesia	9.09
Treatment	13.22
Nutrition	4.03
General care and structure	18.39
Clinical information system	11.98

Improvement proportion related to AASTRE

A total of 961 patient-days were analyzed. The overall proportional improvement after AASTRE was 8.3%. Table 4 reports the improvement proportion related to each blocks of safety measures (IPR-AASTRE-B): values were above 10% for the blocks mechanical ventilation, treatment, general care and structure, and clinical information system.

Comparison of pre-AASTRE and post-AASTRE SCORE survey results

Table 5 compares the pre-AASTRE and post-AASTRE SCORE survey results in each domain. Post-AASTRE scores were better in the following domains: learning environment, perception of local leadership, teamwork climate, safety climate, participation in decision-making and advancement in the organization. Scores for the domain work-life balance remained unchanged between evaluations, and scores for the domains workload and burnout climate were worse on the post-AASTRE assessment.

Table 5 Differences between pre-AASTRE and post-AASTRE SCORE survey results.

Domain	Pre-AASTRE		Post-AASTRE		<i>p</i>
	Mean	SD	Mean	SD	
1. Learning environment	50.55	20.62	60.76	23.66	<0.0001
2. Local leadership	47.98	23.57	62.82	27.46	<0.0001
3. Burnout climate	64.19	20.41	71.87	21.21	0.001
4. Burnout	44.97	28.40	44.64	28.14	0.95
5. Teamwork climate	51.19	18.55	55.89	20.25	0.031
6. Safety climate	45.07	17.60	50.36	19.65	0.012
7. Professional growth opportunities	2.19	0.62	2.23	0.65	0.9
8. Workload	2.99	0.92	3.54	0.90	<0.0001
9. Participation in decision-making	3.00	0.82	3.65	0.87	<0.0001
10. Advancement in the organization	3.21	0.77	4.04	0.77	<0.0001
11. Work-life balance	2.48	0.85	2.59	0.88	0.255

Table 6 Difference in pre-AASTRE and post-AASTRE SCORE survey results, according to professional classification.

Professional category	Physician	Nurse	Experience ≥10 years	Experience <10 years	Senior employee	Junior employee	Previous experience with AASTRE	No previous experience with AASTRE
<i>Domain</i>								
1. Learning environment	+	+	+	+	ND	+	NS	+
2. Local leadership	+	+	+	+	ND	+	NS	+
3. Burnout climate	–	–	ND	ND	–	ND	–	ND
4. Burnout	ND	ND	ND	ND	ND	ND	ND	ND
5. Teamwork climate	ND	ND	ND	+	ND	+	ND	+
6. Safety climate	+	ND	ND	ND	ND	+	ND	+
7. Professional growth opportunities	+	+	+	+	ND	+	NS	+
8. Workload	–	–	–	–	–	–	–	–
9. Participation in decision-making	+	+	+	+	+	+	+	+
10. Advancement in the organization	ND	ND	ND	ND	ND	ND	ND	ND
11. Work-life balance	ND	ND	ND	ND	ND	ND	ND	ND

(+): significant improvement between pre/post AASTRE evaluations. (–): significant worsening between pre/post AASTRE evaluations. ND: no difference between pre/post AASTRE evaluations.

Influence of professional-related factors on SCORE survey scores for the different domains

Table 6 shows the effects of AASTRE on the different SCORE survey domains broken down by professional-related factors. In the domains learning environment, local leadership, and participation in decision-making, post-AASTRE scores were better across all professional-related factors. In the domain professional growth opportunities, post-AASTRE scores were better for all professional subgroups except senior professionals. Detailed information about the differences between pre-AASTRE and post-AASTRE SCORE survey results for all subgroups is reported in the Supplementary Material B (also differences in SCORE survey domains between pre-AASTRE and post-AASTRE evaluations, according to ICUs' experience in using AASTRE – Table 3).

Discussion

Our results validate the cross-cultural adaptation of the SCORE survey into Spanish and demonstrate its usefulness in analyzing the impact of the tool we devised to minimize clinical errors. This adaptation allows important aspects of healthcare organizations to be measured and compared across institutions. This cross-cultural adaptation employed methods similar to those used in other adaptations, relying on healthcare professionals and translators experienced in medical texts.¹⁸ Although various approaches to translation of medical questionnaires have been described, there is no evidence to favor any particular approach.¹⁹

AASTRE are an evidence-based proactive method to increase safety in healthcare.^{14,17} Moreover, Improvement proportion related to AASTRE can be considered a process indicator that measures the degree to which the tool can improve compliance with essential tasks that sometimes go uncompleted due to the complexity and shifting circumstances of ICUs' clinical activity. We found greater than 10% proportional improvement after AASTRE in four of the eight blocks of safety measures. This data means that (in those blocks) when AASTRE was used, in more than 10% of the occasions the clinical practice was changed (converting unsafe situations into safe ones), emphasizing the difficulty of standardizing healthcare.¹⁵

When comparing the results of the SCORE survey administered before and after the implementation of AASTRE, we found significant improvements in 6 domains: learning environment, perception of local leadership, teamwork climate, safety climate, participation in decision-making and advancement in the organization. AASTRE approach calls for direct interaction between the senior attending physician and all professionals responsible for the patient (residents, nurses, and nurses' aides), promoting effective communication in the context of continuous efforts to improve clinical practice, considered essential for building a safety climate.²⁰ Sexton et al.²¹ found a strong correlation between healthcare workers' perception that they had received practical feedback after safety rounds and improvements in the domains learning environment and participation in decision-making. Thus, gains from AASTRE likely result from direct and immediate feedback in interactions between professionals.

The improvement in the domain local leadership is not surprising. Effective leadership and a productive teamwork climate require the determination to commit to a common goal and standardize care delivery and to involve all types of professionals in striving toward that goal.²² AASTRE embody these elements because they are based on applying scientific evidence to care delivery. Another interesting finding that could be related with effective leadership is that the improvements in the domains learning environment, local leadership, teamwork climate, safety climate, and professional growth opportunities were significantly greater in hospitals without prior experience in AASTRE than in those that were already using AASTRE before the study. This difference could also be related to effective leadership, since local leaders' decisions to undertake projects to improve care delivery have been associated with significant changes in the workplace.^{23,24} In any case, these data open the door to a new working hypothesis: AASTRE tool is more effective in units without experience in its use. This would make it necessary to consider new ways of using AASTRE.

However, not all changes after the implementation of AASTRE were positive. In the post-AASTRE SCORE assessment, the domains burnout climate and workload had worsened. The worsening in burnout climate affected both physicians and nurses and was more pronounced in hospitals with experience in AASTRE and after professionals recognized feedback. In the workload domain, both physicians and nurses experienced a significant increase, regardless of years of working experience, type of hospital, or feedback. These results differ from those reported by Sexton et al.²¹ who found that appropriate feedback during safety rounds was associated with an improvement in burnout climate. These differences might be due to the different scenarios in which the safety rounds were implemented. Sexton's study took place in general hospital wards, where the diseases and care, organization of teams, and even staff's mindsets and clinical reasoning differ from those of the ICU scenario.²⁵ It cannot be ruled out that the systematic use of AASTRE, and the continuous changes – corrections – that were made in clinical practice, may have caused the professional to have a feeling of "delivery of inappropriate care" perception, aspect that can increase the burnout climate.²⁶ Given the complexity of the ICU environment, any added task could be perceived as a significant increase in workload, reflected in affirmative responses to statements in the SCORE survey such as "People in this work setting are working too hard on their jobs". These results could also reflect the potential of AASTRE to increase awareness of the difficulties of practicing evidence-based medicine in a highly complex environment.²⁷ Finally, despite the reliability of the instruments used to measure perceived workload, professionals' responses have a subjective component.²⁸

To maximize the benefits of using AASTRE, it is essential to minimize increases in burnout climate and perceived workload. To this end, it is important to ensure that AASTRE do not disrupt professionals' workflow. Pastores et al.²⁹ found that fatigue perception in healthcare settings could be reduced if tasks are recognizable and known in advance, alleviating cognitive workload derived from the density of information that transpire in ICUs. Thus, when choosing the time chosen to carry out safety rounds, prompters should take care to minimize disruptions in workflow. Furthermore,

it could be beneficial for healthcare professionals to receive periodic feedback on quality indicators to help them appreciate the correlation between their efforts and favorable outcomes.³⁰

There are limitations to this study. First, it was considered only professionals that worked the morning shift; implementing AASTRE in other shifts might yield different results. Second, although no changes have been introduced period in the care protocols during the study, other variables different from those studied may have influenced the results (for example, a plan for improving the humanisation of intensive care, developed in all participating ICU). Third, the study does not consider the analysis of the incidence of adverse events during the study period. Fourth, the results of the study may be less robust due to the participation of a relatively small number of ICU. Moreover, the response rate and resultant sample size are limited. Importantly, we did not measure workload objectively, so we cannot contrast professionals' perceptions. Finally, some SCORE domains could be affected by cyclical changes that could influence professionals' perception of their environment.

Conclusion

The cross-cultural adaptation of the SCORE survey into Spanish is a useful tool for ICUs. AASTRE was associated with improvements in six SCORE domains, including safety climate. Perceptions of work overload could be reduced if prompters choose the time to carry out safety rounds to minimize disruptions to workflow.

Authors' contributions

All authors have contributed equally to the following tasks: conception and design of the study, collection and statistical analysis of results, discussion, drafting of the manuscript and critical review of the manuscript.

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Conflicts of interest

None declared.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.medin.2021.03.015](https://doi.org/10.1016/j.medin.2021.03.015).

References

- Schwartz SP, Adair KC, Bae J, Rehder KJ, Shanafelt TD, Profit J, et al. Work-life balance behaviours cluster in work settings and relate to burnout and safety culture: a cross-sectional survey analysis. *BMJ Qual Saf.* 2019;28:142–50.
- Sevransky JE, Chai ZJ, Cotsonis GA, Cobb JP, Pastores SM. Survey of annual staffing workloads for adult critical care physicians working in the United States. *Ann Am Thorac Soc.* 2016;13:751–3.
- Sarani B, Toevs C, Mayglothling J, Kaplan LJ. The burden of the U.S. crisis in the surgical critical care workforce and workflow. *Am Surg.* 2015;81:19–22.
- Bagshaw SM, Opgenorth D, Potestio M, Hastings SE, Hepp SL, Gilfoyle E, et al. Healthcare provider perceptions of causes and consequences of ICU capacity strain in a large publicly funded integrated health region: a qualitative study. *Crit Care Med.* 2017;45:e347–56.
- Chuang CH, Tseng PC, Lin CY, Lin KH, Chen YY. Burnout in the intensive care unit professionals: a systematic review. *Medicine.* 2016;95:e5629.
- Laschinger HKS, Leiter MP. The impact of nursing work environments on patient safety outcomes: the mediating role of burnout engagement. *J Nurs Adm.* 2006;36:259–67.
- Edmondson AC, Higgins M, Singer S, Weiner J. Understanding psychological safety in health care and education organizations: a comparative perspective. *Res Hum Dev.* 2016;13:65–83.
- Sexton JB, Thomas EJ, Grillo SP. The Safety Attitudes Questionnaire: guidelines for administration. In: Technical report 03-02. 2003.
- Gutiérrez-Cía I, de Cos PM, Juan AY, Obón-Azuara B, Alonso-Ovies J, Martín-Delgado MC, et al. Perception of safety culture in Spanish intensive care units. *Med Clin.* 2010;135:37–44.
- Sexton JB, Leonard M, Frankel A, Adair KC. Technical report 16-8: SCORE: assessment of your work setting safety, communication, operational reliability, and engagement; 2016. Available at: http://www.dukepatientsafetycenter.com/doc/SCORE_Technical_Report_5.22.17.Pdf [accessed 26.01.20].
- Profit J, Lee HC, Sharek PJ, Kan P, Nisbet CC, Thomas EJ, et al. Comparing NICU teamwork and safety climate across two commonly used survey instruments. *BMJ Qual Saf.* 2016;25:954–61.
- Sexton JB, Holzmüller CG, Pronovost PJ, Thomas EJ, McFerran S, Nunes J, et al. Variation in caregiver perceptions of teamwork climate in labor and delivery units. *J Perinatol.* 2006;26:463–70.
- Sirgo G, Olona M, Martín MC, Esteban F, Pobo A, Bodí M, et al. Audits in real time for safety in critical care: definition and pilot study. *Med Intensiva.* 2014;38:473–82.
- Bodí M, Olona M, Martín MC, Alceaga R, Rodríguez JC, Corral E, et al. Feasibility and utility of the use of real time random safety audits in adult ICU patients: a multicentre study. *Intensive Care Med.* 2015;41:1089–98.
- Bodí M, Oliva I, Martín MC, Gilavert MC, Muñoz C, Olona M, et al. Impact of random safety analyses on structure, process and outcome indicators: multicentre study. *Ann Intensive Care.* 2017;7:23.
- Marhuenda D, Prieto MJ, Cardona A, Roel JM, Oliveras MA. Transcultural adaptation and validation of the Spanish version of EUROQUEST. *Neurología.* 2015;4:201–7.
- Bodí M, Oliva I, Martín MC, Sirgo G. Real-time random safety audits: a transforming tool adapted to new times. *Med Intensiva.* 2017;41:368–76.
- Fernández A, Vallverdú H, Román B, Aris MC, Berrada JJ. Transcultural validation to Spanish of the Patient Evaluation of Emotional Care During Hospitalisation Questionnaire. *J Health Qual Res.* 2019;34:185–92.

19. Acquadro C, Conway K, Hareendran A, Aaronson N. Literature review of methods to translate health-related quality of life questionnaires for use in multinational clinical trials. *Value Health*. 2008;11:509–21.
20. Randmaa M, Mårtensson G, Leo Swenne C, Engström M. SBAR improves communication and safety climate and decreases incident reports due to communication errors in an anaesthetic clinic: a prospective intervention study. *BMJ Open*. 2014;4:e004268.
21. Sexton JB, Adair KC, Leonard MW, Frankel TC, Proulx J, Watson SR, et al. Providing feedback following Leadership WalkRounds is associated with better patient safety culture, higher employee engagement and lower burnout. *BMJ Qual Saf*. 2018;27:261–70.
22. Keats JP. Leadership and teamwork: essential roles in patient safety. *Obstet Gynecol Clin North Am*. 2019;46:293–303.
23. Kirk J, Andersen O, Petersen J. Organizational transformation in health care: an activity theoretical analysis. *J Health Organ Manag*. 2019;8:547–62.
24. Pellerin MA, Lamontagne ME, Viau-Guay A, Poulin V. Systematic review of determinants influencing knowledge implementation in occupational therapy. *Aust Occup Ther J*. 2019;66:670–81.
25. de Bock BA, Willems DL, Weinstein HC. Complexity perspectives on clinical decision making in an intensive care unit. *J Eval Clin Pract*. 2018;24:308–13.
26. Kerlin MP, McPeake J, Mikkelsen ME. Burnout and joy in the profession of critical care medicine. *Crit Care*. 2020;24:98.
27. Marra A, Ely EW, Pandharipande PP, Patel MB. The ABCDEF bundle in critical care. *Crit Care Clin*. 2017;33:225–43.
28. Briatte I, Allix-Béguec C, Garnier G, Michel M. Revision of hospital work organization using nurse and healthcare assistant workload indicators as decision aid tools. *BMC Health Serv Res*. 2019;19:554.
29. Pastores SM, Kvetan V, Coopersmith CM, Farmer JC, Sessler C, Christman JW. Workforce, workload, and burnout among intensivists and advanced practice providers: a narrative review. *Crit Care Med*. 2019;47:550–7.
30. Gude WT, Roos-Blom MJ, van der Veer SN, Dongelmans DA, de Jonge E, Francis JJ, et al. Health professionals' perceptions about their clinical performance and the influence of audit and feedback on their intentions to improve practice: a theory-based study in Dutch intensive care units. *Implement Sci*. 2018;13:33.