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ORIGINALES

Confirmatory factor analysis of the safety attitudes questionnaire/operating room

Análise fatorial confirmatória do questionário de atitudes de segurança/centro cirúrgico Análisis factorial confirmatorio del cuestionario de actitudes de seguridad/centro quirúrgico

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ABSTRACT:

Objective: To analyze the factor structure of the version of the Safety Attitudes Questionnaire/Operating Room Version that has been translated and culturally adapted to the Brazilian context.

Method: This was a methodological study about a questionnaire. The questionnaire was administered to 412 health professionals who worked in operating rooms. The factor structure was tested with confirmatory factor analysis (CFA) and Cronbach's alpha. Results: The total score for Cronbach's alpha was 0.912; and the scores for the domains ranged from 0.56 and 0.85. The domain with the worst performance was communication in the surgical setting.

The **results** of CFA showed that the score for SRMR was 0.052, RMSEA, 0.031, and CFI, 0.95. These scores indicate the reliability and acceptability of the Brazilian adaptation of the questionnaire. **Conclusion**: The factor structure demonstrated the validity and reliability of the Brazilian version of the questionnaire for measuring the patient safety climate as perceived by healthcare professionals who worked in surgical settings

Key words: Patient Safety; Surgicenters; Perioperative Nursing; Validation Studies.

RESUMO:

Objetivo: Analisar a estrutura fatorial da versão traduzida e adaptada culturalmente do Safety Attitudes Questionnaire/Operating Room Version para o contexto brasileiro.

Método: Trata-se de um estudo metodológico sobre o questionário. O questionário foi aplicado a 412 profissionais de saúde atuantes em centros cirúrgicos. A avaliação do questionário foi realizada com base na Análise Fatorial Confirmatória (AFC) e no alpha de Cronbach.

Resultados: O valor total do alpha de Cronbach foi 0,912; nos domínios os valores variaram de 0,56 a 0,85. O pior domínio foi Comunicação no Ambiente Cirúrgico. Os achados da AFC demonstraram que o

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valor de SRMR foi de 0,052; o RMSEA de 0,031 e o de CFI de 0,95. Esses valores demonstram a confiabilidade e um ajuste de modelo aceitável da versão brasileira do SAQ/OR.

Conclusão: A estrutura fatorial demonstrou que a versão brasileira do questionário é válida e confiável para mensurar o clima de segurança do paciente na percepção dos profissionais de saúde que atuam no ambiente cirúrgico.

Palavras-chave: Segurança do Paciente; Centros Cirúrgicos; Enfermagem Perioperatória; Estudos de Validação.

RESUMEN:

Objetivo: Analizar la estructura factorial de la versión traducida y adaptada culturalmente del *Safety Attitudes Questionnaire / Operating Room Version* para el contexto brasileño.

Método: Fue desarrollado un estudio metodológico acerca del cuestionario. El cuestionario fue aplicado a 412 profesionales de salud trabajadores en centros quirúrgicos. La evaluación del cuestionario fue realizada con base en Análisis Factorial Confirmatorio (AFC) y en el alfa de Cronbach. **Resultados:** El valor total del alfa de Cronbach fue 0,912; en los dominios los valores variaron de 0,56 a 0,85. El peor dominio fue Comunicación en el Ambiente Quirúrgico. Los hallazgos de la AFC mostraron que el valor de SRMR fue de 0,052; el RMSEA de 0,031 y el de CFI de 0,95. Estos valores demuestran la confiabilidad y un ajuste de modelo aceptable de la versión brasileña del SAQ / OR. **Conclusión:** la estructura factorial mostró que la versión brasileña del cuestionario es válida y confiable para medir el clima de seguridad del paciente en la percepción de los profesionales de salud que trabajan en el ambiente quirúrgico.

Palabras Claves: Seguridad del paciente; Centros Quirúrgicos; Enfermería Perioperatoria; Cuestionarios; Estudios de Validación.

INTRODUCTION

Errors and adverse events in health care have been intensely discussed worldwide because of their impact on people's lives, whether patients, professionals or managers, as well as on healthcare systems.

The estimated care and economic impacts of adverse events in Brazil were published in a 2018 report on hospital care safety. The results showed that in 2016, in both the private and public hospital systems, 1,377,243 Brazilians were victims of an acquired condition (adverse event). The authors inferred that conditions acquired in hospitals caused 120,514 to 302,610 deaths, and established that 302,610 was representative of the Brazilian reality. The study confirmed that, along with increased hospital morbimortality, adverse events incur significant social costs, since the burden of hospital care errors in the private system reached R\$ 15.57 billion⁽¹⁾.

One of the many challenges inherent to the health sector is the surgical environment, where complex interdisciplinary activities are performed that are strongly dependent on individual actions, with a high risk of adverse events (AEs) (2,3).

Surgery is considered one of the most complex and expensive services provided by healthcare systems. A study in the United States conducted in 2012 showed approximately 312.9 million surgery-related deaths around the world⁽⁴⁾. Additionally, according to the World Health Organization (WHO), half of the adverse events that occured with hospitalized patients were relative to surgical care, of which at least half could have been prevented, pointing to the impact of unsafe surgical care in healthcare systems⁽⁵⁾.

Another literature review identified that approximately 48% of all adverse events were related to surgical and anesthetic procedures, and that 30% to 50% of these were preventable ⁽⁶⁾.

It is especially important to analyze surgical AEs because of their frequency. Brazilian cost estimates associated with patients who are victims of surgical AEs indicate an increase in the costs of hospital care, because in approximately 45% of AEs, the mean hospital stay was extended 14 days⁽⁷⁾.

Thus, measuring and analyzing safety culture in health organizations based on the perceptions of the safety climate by healthcare professionals allows the identification and management of aspects directed toward patient safety. This type of assessment can provide the basis for situational diagnoses, continuing education programs, care protocols, and monitoring AEs and quality of care.

The literature demonstrates that safety culture has been evaluated using psychometric questionnaires, with specific versions for different hospital settings⁽⁸⁾.

Therefore, research instruments need to be translated and adapted to various cultures and countries to maintain their content, psychometric characteristics, and validity when administered to different populations⁽⁹⁾.

Validity and reliability are among these psychometric properties. The assessment of internal consistency, which in the literature is called reliability, measures the consistency with which a given set of measurement items estimates a construct or latent dimension⁽¹⁰⁾. Thus, it is considered a measurement of the level of consistency between the measurements of a variable⁽¹¹⁾.

One such instrument that measures safety climate is the Safety Attitudes Questionnaire (SAQ)⁽¹²⁾, which has been translated and validated in various countries, including Germany, Norway, Turkey, China, Sweden, Denmark and Greece⁽¹³⁻¹⁹⁾. However, considering the specificities of healthcare services, the SAQ was constructed for clinical medicine, intensive care, surgery wards, and outpatient settings⁽¹²⁾.

The Safety Attitudes Questionnaire/Operating Room (SAQ/OR) is a version of the SAQ adapted to the surgery ward that was developed by researchers at the University of Texas. It presents the same properties as the generic SAQ version in terms of the construct of patient safety, adapted to the surgical setting and the answer scale (20). The SAQ/OR has been translated and adapted in Sweden, Japan and Portugal, maintaining its psychometric properties, (21-23) and both the original and culturally adapted versions of the SAQ and the SAQ/OR present good psychometric properties. The SAQ/OR was culturally adapted and validated in Brazil in a study with 590 subjects who worked in four hospitals in the municipality of São Paulo (24). The result instrument in Portuguese called Questionário de Atitudes Segurança/Centro Cirúrgico (SAQ/CC), with 40 items and 6 domains. The following domains emerged: safety climate; perception of management; perception of stress; working conditions; communication in the operating room; and perception of professional performance⁽²⁵⁾. The questionnaire has been shown to be reliable, with an overall Cronbach's alpha of 0.87, ranging between 0.59 and 0.82 among domains. The reliability of the SAQ/CC is similar to that of other cultural adaptation studies of the SAQ/OR⁽²¹⁻²³⁾

The Brazilian cultural adaptation and validation of the SAQ/CC used exploratory factor analysis (EFA) because the SAQ/OR dimensions (latent factors or dimensions) were not present. Two of the domains found in the present study did not emerge in the generic version of the SAQ: communication in the surgical setting and perception of professional performance. (25)

Thus, in the present study, confirmatory factor analysis was used to deepen the understanding of the psychometric properties of the SAQ/CC.

OBJECTIVE

To analyze the factor structure of the translated and culturally adapted version of the Safety Attitudes Questionnaire/Operating Room Version to the Brazilian context.

MATERIALS AND METHOD

The aim of this methodological study was to analyze the Brazilian SAQ/CC using confirmatory factor analysis.

Psychometric studies require that the statistical resources used to validate instruments include different factor analysis techniques. Their main function is to reduce a large number of observed variables to a lower number of factors that represent latent constructs or dimensions^(11,26).

Factor analysis analytical techniques are exploratory or confirmatory. In exploratory factor analysis (EFA), the components to be extracted or the variables that make up the constructs or latent dimensions are not known a priori⁽¹¹⁾.

Confirmatory factor analysis is used to test the goodness of fit of the factors/constructs defined by EFA (11).

Confirmatory factor analysis is defined as a confirmatory procedure, and is a method used primarily to assess the construct validity of measurements rather than for data reduction⁽²⁷⁾ Additionally, it is used to confirm established factor structures and to test whether the theoretical factor analysis fits the observed data.

The study population consisted of healthcare professionals who worked in operating rooms, according to the following inclusion criteria:

- Nurses, nursing technicians and aides who had at least six months of experience in the unit who were working at the time of data collection.
- > Surgeons, residents, anestheseologists and surgical technologists who participated in at least three procedures/month.

Sample calculation resulted in 400 participants, with 10 subjects for each item in the SAQ/CC. Based on this, a convenience sample of 412 participants was selected.

The study was conducted in three public hospitals and one private hospital in the states of São Paulo, Rio de Janeiro and Bahia. To preserve anonymity, the participating institutions were called A, B, C and D.

Institution A was a public teaching hospital located in the municipality of São Paulo, classified as an extra-capacity hospital. The surgery ward consisted of 40 operating rooms, with an average of 2,000 procedures conducted per month.

Institution B was a private, tertiary and philanthropic hospital located in the municipality of São Paulo. The surgery ward had 25 operating rooms and carried out an average of 2,750 procedures per month.

Institution C was part of the Unified Health System (SUS) as a reference in high-complexity tertiary care in the metropolitan region of the state of Rio de Janeiro. It was a medium-capacity federal public hospital. The surgery ward consisted of five operating rooms, which performed approximately 90 surgeries per month.

Institution D was a general public teaching hospital, a reference in medium-to-high complexity care for the state of Bahia. The institution was considered large-capacity. Its surgical ward had five operating rooms and performed 300 surgeries per month.

The Instrument: Safety Attitudes Questionnaire/Operating Room (SAQ/CC)

The SAQ/CC version of the questionnaire is divided into three parts. The first refers to the quality of communication and collaboration among professionals who work in the surgical setting, where subjects must respond in terms of their relationship with each professional category. The second consists of 40 statements that encompass patient safety and one item asking whether the respondent had ever answered the questionnaire before. The third part gathers demographic information (gender, race/ethnicity, professional category, and time in profession, among others). The instrument also has a blank space where respondents are asked to write three recommendations to improve patient safety in the operating room.

In all, the instrument consists of 40 items answered on a 5-point Likert scale, one question with a simple yes/no answer option about whether the respondent had ever taken the questionnaire before, and a blank space for recommendations.

The authors of the original questionnaire scored it as follows: "completely disagree" equals 0 points, "partially disagree," 25 points, "neither agree nor disagree," 50 points, "partially disagree," 75 points, and "completely agree," 100 points. The alternative "Does not apply" was not considered when calculating the score. Score calculation followed these steps: first, negative items are reversed; next, they are grouped in domains, and the score for each domain is obtained by calculating the mean total score, i.e., the sum of the scores for the items in each domain divided by the number of items in the domain The scale ranges from 0 to 100, with 0 for the worst perception of safety climate and 100 for the best. Scores higher than or equal to 75 represent a positive perception of patient safety⁽¹²⁾.

The SAQ/CC domains and their respective items/statements were extracted from the PhD thesis that adapted and validated the instrument to the Brazilian context⁽²⁵⁾.

Chart 1: Description of the items in each SAQ/CC domain

Safety Climate

- 30. All the Operating Room staff takes responsibility for patient safety
- 35. Here, there is high adherence to clinical guidelines and evidence-based criteria relative to patient-safety
- 38. The information gathered through adverse event reports is used to make patient care safer in this Operating Room
- 34. Important matters are well communicated during shift changes
- 32. Patient safety is constantly reinforced as a priority here in the Operating Room
- 28. Morale in this Operating Room is high
- 29. The medical team in this Operating Room does a good job

Perception of Management

- 6. This hospital's administration supports my daily efforts
- 5. This hospital's administration is doing a good job
- 7. I get adequate feedback about my performance
- 11. This hospital is a good place to work
- 14. In this Operating Room, the number of professionals is sufficient for the number of patients

Perception of Stress

- 31.(N) I feel tired when I get up in the morning and bave to face another day of work
- 33.(N) I feel exhausted from my work
- 37.(N) I feel I am working too much
- 36.(N) I feel frustrated with my work

Work Conditions

- 17. Safety culture in this Operating Room makes it easy to learn from others' mistakes
- 23. I am familiar with the appropriate means to refer issues relative to patient safety in this Operating Room
- 22. I receive adequate and timely information about occurrences in the hospital, which can affect my work
- 18. The hospital handles problematic professionals constructively
- 26. It is easy for professionals who work in this Operating Room to ask questions when there is something they don't understand
- 16. I am encouraged by my coworkers to report any concerns I may have about patient safety

Communication in the Surgical Environment

- 19. The equipment in this Operating Room is suitable
- 15. Decision-making in the Operating Room is based on information from the professionals involved
- 9. Transmitting information among professionals in the Operating Room before carrying out a surgical procedure is important to patient safety
- Transmitting information is common in the Operating Room.

Perception of Professional Performance

- 24.(N) I am less efficient at work when I'm tired
- 21.(N) When my workload becomes excessive, my performance is hindered
- 12.(N) Tiredness harms my performance during emergency situations
- 25.(N) I am more likely to make mistakes in tense or hostile situations
- *(N) reverse/negative items

Data collection took place between September 2016 and March 2017.

Meetings were held with the directors, managers and members of the surgery ward teams to explain the objective and methods of the study. The data were gathered by the researcher and a person trained by her.

The professionals were approached in the surgery ward; before answering the questionnaire, they signed informed consent forms. At this time, the researchers explained the objectives of the study and provided instructions about how to answer the instrument and the estimated time for completion (15 minutes)⁽¹²⁾.

Based on the list of surgical staff and the surgery schedule, data collection took place between Monday and Friday. Considering the dynamics of the operating room and the need to represent all professional categories, the questionnaires were distributed in person - in some units, to the nursing managers or the coordinators of medical teams - and collected at a later time.

The data were organized on an electronic spreadsheet and analyzed using statistical computer programs.

The data were submitted to CFA to validate the questionnaire's constructs, and reliability was measured with Cronbach's alpha.

The results are presented below in charts, tables and figures, and descriptive variables, according to absolute and relative frequencies and measures of central tendency.

The cultural adaptation and validation of the SAQ/OR was authorized by the original authors via electronic contact.

The project was approved by the research ethics committees of the School of Nursing of the University of São Paulo and the co-participating institutions under protocol no. 1.596.349 of June 16, 2016 and Certificate of Presentation for Ethical Appraisal: 52951116.8.0000.5392.

All subjects volunteered to participate and their anonymity was ensured when presenting the results. The researchers explained the objectives and study method and the participants were given an invitation letter and two copies of an informed consent form to sign, drafted according to Resolution 466/12 of the Brazilian National Health Council.

RESULTS

Descriptive analysis of the questionnaire

To validate the psychometric properties of the SAQ/CC, it was administered to a sample of 412 subjects, of whom 150 were at institution A, 145 at institution B, 64 at institution C, and 53 at institution D.

Descriptive analysis was conducted for the answers and the sociodemographic data using frequency distribution and summary measures: mean, median, standard deviation, and maximum and minimum values. Table 1 shows that in terms of professional category, most participants were surgery technologists or circulating

nurses, with 112 (27.5%), followed by 89 (21.8%) surgeons/assistant surgeons and 76 (18.6%) anesthesiologists/assistant anesthesiologists. The medical team represented 59.3% of the sample (surgeons, anesthesiologists, surgical and anesthesiology residents) and the nursing team (nurses, nursing technicians, surgical technologists and circulating nurses) represented 39.7%.

Regarding gender, most were male (52.9%) and white (66.8%). Regarding work arrangements and schedules, most worked full time, with 176 (44.4%), and full shifts, with 153 (45%).

Table 1: Distribution of participants by professional category, sex, ethnicity/race, work arrangement and work schedule. São Paulo, São Paulo, Brazil, 2017.

VARIABLES*	N	%			
Professional category					
Surgeon/Assistant surgeon	89	21.8%			
Surgical resident or intern	44	10.8%			
Surgical techonlogist or circulating nurse	112	27.5%			
Perfusionist	8	2.0%			
Anesthesiologist/Assistant anesthesiologist	76	18.6%			
Anesthesiology resident	33	8.1%			
Anesthesiologist assistant	4	1.0%			
OR nurse	28	6.9%			
PACU nurse	2	0.5%			
Bedside nurse	5	1.2%			
OR charge nurse	3	0.7%			
Support team	3	0.7%			
Other	1	0.2%			
TOTAL	408	100%			
Work arrangement					
Full time	176	44.4%			
Part time	132	33.3%			
Coop member	8	2.0%			
Employee	37	9.3%			
Others	43	10.9%			
TOTAL	396	100%			
Ethnicity					
Black	34	8.7%			
Indigenous	1	0.3%			
Asian	16	4.1%			
African-Brazilian	0	0.0%			
Brown	79	20.2%			
White	262	66.8%			
TOTAL	392	100%			
Schedule					
Full time	153	45.0%			
Part time	84	24.7%			
Night	3	0.9%			

Variable	100	29.4%
TOTAL	340	100%
Sex		
Male	213	52.9%
Female	190	47.1%
TOTAL	403	100%

Source: Created by the authors

The age of the health professionals varied from 24 to 81 years, with a mean age of 37.61 years (±10.61) and a median of 35. In terms of time of work experience in their specialty, it varied between 1 and 54 years, with a mean of 11.14 years (±9.98), and time working at the institution ranged from 6 months to 57 years, with a mean of 9.03 years (±9.19).

During the data collection process, questions arose about the professional positions and categories. This was relative to the surgical technologists and circulating nurses being categorized under one alternative in the part of the questionnaire that describes communication and collaboration among health professionals and in the part about personal information.

Thus, on analyzing the professional categories that make up the instrument, the researchers found it necessary to modify the types of nursing categories, as shown in Appendix 1.

It is important to emphasize that the changes made refer to the nursing team; however, to maintain the instrument's layout, the category "bedside nurse" was removed, because there were four categories of nurses, and bedside nurses were referred to as OR nurses.

Validation of the questionnaire

The questionnaire's reliability was assessed based on its internal consistency using Cronbach's alpha, and the results showed that the instrument is reliable, with a total alpha of 0.91. In terms of domains, the scores ranged between 0.85 and 0.56, as illustrated in Table 2.

Table 2: Description of Cronbach's alpha and SAQ/CC domains. São Paulo, São Paulo, Brazil, 2017.

SAQ/CC domains	Number of items	Cronbach's alpha			
Total SAQ	40	0.91			
Safety Climate	7	0.85			
Perception of Management	5	0.80			
Perception of Stress	4	0.78			
Working Conditions	6	0.78			
Communication in the surgical environment.	4	0.56			
Perception of professional performance	4	0.77			

Source: Created by the authors

The results of CFA are presented in Table 3. The index scores show a satisfactory goodness-of-fit of the final SAQ/CC model. The SRMR was 0.052, RMSEA was 0.031, and CFI was 0.95. According to the literature, (11) these values demonstrate acceptable goodness-of-fit of the Brazilian version of the SAQ/OR.

Table 3: Confirmatory factor analysis index scores. São Paulo, São Paulo, Brazil, 2017.

Index scores	N > 410 m>=40			
Comparative Fit Index (CFI)	0.958			
Root Mean Square Error of Approximation (RMSEA)	0.031			
Standardized Root Mean Square Residual (SRMR)	0.052			
Tucker-Lewis Index (TLI)	0.953			

Source: Created by the authors; N - number of observations; m - number of observable variables

DISCUSSION

The analysis of the sociodemographic data shows that the sample was represented mostly by white male health professionals. The data corroborate those found in the study conducted to translate, adapt and validate the SAQ/OR to the Brazilian context⁽²⁵⁾. No significant differences were found in terms of sex and ethnicity. These data are in accordance with those in a study carried out by the Federal Council of Medicine, which showed a predominance of men in their forties⁽²⁸⁾.

In the present study, the medical category represented 59.3% of the sample, and the nursing staff, 39.7%, while in the SAQ/OR validation study, the medical category represented 68.5% of the sample and nursing, 31.3%⁽²⁵⁾, pointing to a more evenly distributed sample. However, it is worth emphasizing that in the surgical setting, the nursing team was in constant activity before, during and after surgical procedures and therefore had less time to answer the questionnaire.

The literature on the realiability of research instruments indicates that a questionnaire is consistent when the total Cronbach's alpha varies between 0.70 and 0.95⁽²⁹⁾.

The results of this investigation are similar to those of other SAQ/OR validation studies. In the Japanese adaptation, the total Cronbach's alpha was 0.74, in Portugal, 0.90, and in the study developed in Switzerland, the alphas for the domains ranged from 0.59 to 0.83⁽²¹⁻²³⁾.

On comparing the score obtained in this study (0.91) with the cross-cultural adaptation and validation of the SAQ/OR to the Brazilian context, whose total alpha was 0.87 and the domains ranged between 0.82 and 0.59, (25) the results are analogous. However, total and domain scores were higher, except for the domain "communication in the operating room."

Among the domains of the Brazilian SAQ/CC version, it is worth emphasizing that two domains are specific to the version for the surgical ward: communication in the operating room and perception of professional performance⁽²⁵⁾.

In this direction, communication in the operating room includes four items, and its items refer to the information shared among health professionals that interferes with patient safety, obtaining the lowest alpha score. Considering that the authors of the original instrument proposed measuring communication and collaboration among professional categories that work in the surgical center in the first part of the questionnaire, and that communication is a crucial aspect in the work process of surgical teams, this domain provides a tool for evaluating team communication and collaboration and patient safety⁽²⁰⁾.

The Cronbach's alpha for perception of professional performance was 0.77, and its items are related to individual ability to recognize and take responsibility for tiredness as a factor that affects professional practice and patient safety.

In the present study, CFA was employed to validate the results obtained from the exploratory factor analysis of the SAQ/CC. Thus, the data were analyzed using statistical resources to confirm the items that make up the domains of the SAQ/CC, which assesses patient safety in the surgical environment.

Of the indexes used in CFA, the comparative fit index (CFI) is one of the most important for testing the model's goodness of fit for measuring the discrepancy between data and the hypothesis model. Comparative fit index scores range from 0 and 1, with higher vales indicating a better model fit. Thus, a CFI greater than 0.95 is currently accepted as an indicator of goodness of fit^(11,30).

The root mean square error of approximation (RMSEA) prevents sample size problems by analyzing the discrepancy between the hypothesis model and the sample's covariance matrix. The RMSEA ranges from 0 to 1, with lower scores indicating better model fit. A score of 0.06 or less indicates an acceptable model fit⁽³⁰⁾. The standardized root mean square residual (SRMR) is the square root of the discrepancy between the sample's covariance matrix and the model's covariance matrix. It ranges from 0 to 1, with scores equal to 0.8 indicating an acceptable model⁽³⁰⁾.

Last, the Tucker-Lewis index (TLI), also known as the non-normalized fit index, demonstrates the quality of fit. The scores are between 0 and 1, and values greater than or equal to 0.90 indicate superior goodness of fit⁽³⁰⁾.

In this regard, considering the indexes presented, the results of the present study are similar to those of other translation, cultural adaptation and validation studies of the SAQ/OR^(21,22,23), and the factor structure shows that the Brazilian version of the questionnaire is valid and reliable.

CONCLUSION

The present study contributed to deepening knowledge of the validation of instruments that measure safety climate. In light of the results, the questionnaire was consolidated as a reliable instrument for measuring safety climate in the surgical environment in the Brazilian context.

Furthermore, this tool can provide input for managers and researchers when constructing and implementing measures and strategies aimed at ensuring safe surgical care and when conducting surveys to assess safety culture.

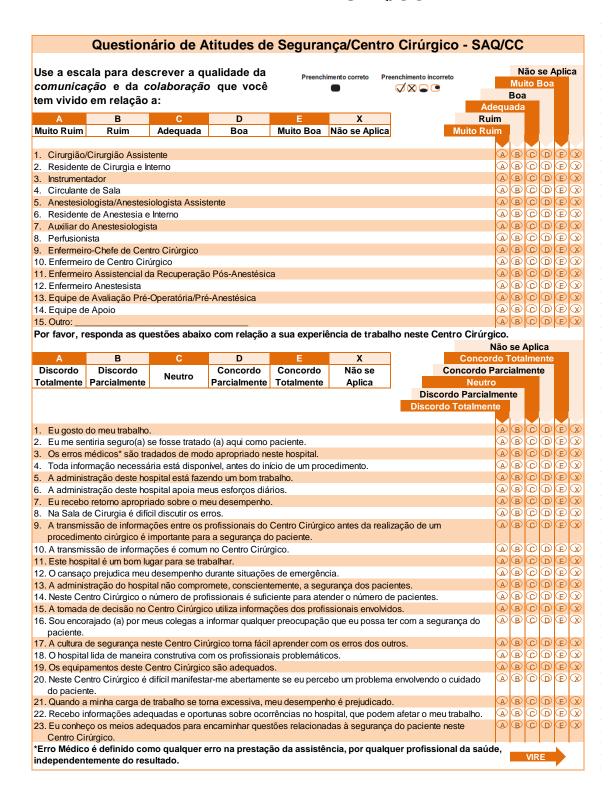
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APPENDIX 1 - SAQ/CC



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