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ARTÍCULO DE INVESTIGACIÓN

Scale for measurement of healthcare-associated infection risk in adult patients: development and content validation

Escala para la medición del riesgo de infección asociada a la atención en salud en pacientes adultos: desarrollo y validación de contenido

Escala para a medição do risco de infecção associada à assistência à saúde em pacientes adultos: desenvolvimento e validação de conteúdo

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Histórico

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Abstract

Introduction: Hospital settings involve several risk factors related to healthcare-associated infections (HAIs). A method that contributes to prevention and control is identification of risks to enable implementation of preventative measures. It is believed that this identification can be accomplished using scales. The present study attempts to develop and validate the face and content of a new scale for measuring HAIs risk in hospitalized adults. **Materials and Methods:** A methodological study conducted to develop and validate the face and content of the Adult Inpatients Infection Risk Assessment scale, which underwent evaluation by a committee of 23 experts with experience in HAIs. The scale's validity was tested using the Content Validity Index (CVI). **Results:** 15 items were retained in the scale, grouped into two dimensions: intrinsic and extrinsic factors. Certain minor adjustments were needed to improve the clarity of some items. Items' CVIs ranged from 0.83 to 1.0 and the scale's mean CVI was 0.90. **Discussion:** The Adult Inpatients Infection Risk Assessment scale can be used as a technology of low cost for the measurement of the risk of infection, which allows the planning of more accurate and organized interventions of the health team targeting at preventive and safe care during hospitalization. **Conclusions:** The findings supported the face and content validity of the Adult Inpatients Infection Risk Assessment Scale.
Key words: Risk Assessment; Validation Studies; Infection Control; Patient Safety.

Resumen

Introducción: El ambiente hospitalario envuelve diferentes factores de riesgo relacionados con las infecciones asociadas a la atención sanitaria (IAAS). Un método que contribuye a la prevención y control es la identificación de riesgos que permita la implementación de medidas preventivas. Se cree que dicha identificación se puede llevar a cabo mediante el uso de escalas. El presente estudio intenta desarrollar y validar la validez aparente y el contenido de una nueva escala para medir el riesgo de IAAS en adultos hospitalizados. **Materiales y Métodos:** Se condujo un estudio metodológico para el desarrollo y la validación aparente y de contenido de la escala de Evaluación de Riesgos de Infección en Pacientes Adultos, la cual se sometió a evaluación por parte de un comité compuesto por 23 expertos con experiencia en IAAS. Se probó la validez de la escala mediante el Índice de Validez de Contenido (IVC). **Resultados:** Se conservaron 15 ítems de la escala y se agruparon en dos dimensiones: factores intrínsecos y factores extrínsecos. Se necesitaron realizar unos pequeños ajustes para mejorar la claridad de algunos ítems. El IVC de los ítems se ubicó entre 0,83 a 1,0 y el IVC medio de la escala fue de 0,90. **Discusión:** La escala de Evaluación de Riesgo de Infección en Pacientes Adultos se puede emplear como una tecnología de bajo costo en la medición del riesgo de infección, lo que permite la planeación de intervenciones más precisas y organizadas de parte del equipo de atención médica con el ánimo de prevenir y proveer un cuidado seguro durante la hospitalización. **Conclusiones:** Los hallazgos soportaron la validación aparente y de contenido de la Escala de Evaluación de Riesgo de Infecciones en Pacientes Adultos.
Palabras clave: Medición de Riesgo; Estudios de Validación; Control de Infecciones; Seguridad del Paciente.

Resumo

Introdução: O ambiente hospitalar abrange diferentes fatores de risco relacionados com as infecções associadas ao atendimento sanitário (IAAS). Um método que contribui com a prevenção e o controle é uma identificação de riscos que permita a implantação de medidas preventivas. Considera-se que essa identificação pode ser realizada mediante o uso de escalas. O presente estudo pretende desenvolver e comprovar a validez aparente, bem como o conteúdo de uma nova escala para medir o risco das IAAS em adultos internados. **Materiais e Métodos:** Foi realizado um estudo metodológico para o desenvolvimento e a validação aparente e de conteúdo da escala de Avaliação de Riscos de Infecção em Pacientes Adultos, que foi analisada por um comitê constituído por 23 especialistas com experiência em IAAS. A validez da escala foi provada mediante o Índice de Validez de Conteúdo (IVC). **Resultados:** Foram mantidos 15 itens da escala e agrupados em duas dimensões: fatores intrínsecos e fatores extrínsecos. Foi necessário fazer alguns pequenos ajustes para melhorar a clareza de alguns dos itens. O IVC dos itens foi de 0,83 a 1,0 e o IVC médio da escala foi de 0,90. **Discussão:** A escala de Avaliação de Risco de Infecção em Pacientes Adultos pode ser utilizada como uma tecnologia de baixo custo para a medição do risco de infecção, permitindo o planejamento de cirurgias mais precisas e organizadas por parte da equipe de atendimento médico, com o intuito de prevenir e oferecer um cuidado seguro durante a internação. **Conclusões:** Os resultados obtidos demonstram a importância da validação aparente e de conteúdo da Escala de Avaliação de Risco de Infecções em Pacientes Adultos.
Palavras chave: Medição de Risco; Estudos de Validação; Controle de Infecções; Segurança do Paciente.

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INTRODUCTION

The prevalence of healthcare-associated infections (HAIs) in developing countries, which is elevated compared with rates in developed countries, is a serious epidemiological and safety problem[1]. HAIs are the most common group of complications seen in hospitalized patients, they impact on morbidity and mortality, and they significantly increase healthcare system costs[2,3].

One study reported that the lack of statistical data on infection rates acquired by surveillance groups is caused by time pressures, resource shortages, and a deficiency of specialized knowledge, since few low and medium income countries have national systems for surveillance of HAIs[1].

However, epidemiological profiles can vary between institutions or even across different departments within a single healthcare establishment, according to the type of care provided[4], because occurrence of HAIs is dependent on many different conditions or factors[5].

Many different risk factors for development of HAIs have been studied in the literature, including variables related to the patients, to treatment, and to the environment[6]. Additionally, one of the strategies used in prevention of HAIs is identification of risk factors, which enables possible conditions that predispose to increased rates or exacerbation of HAIs to be identified.

It is believed that this identification can be accomplished using risk assessment scales[7] and that the success of the endeavor is dependent on a constant search for evidence to aid in healthcare professionals' decision-making processes.

It is important to develop new measurement tools in healthcare[8] because the current tendency is to standardize international norms that contribute to improving teaching, research, and clinical practice. However, researchers have found that such assessment scales are only useful and capable of providing results that are scientifically robust when they have good psychometric properties[9].

The quality of health services and their relationship with HAIs is a subject that is attracting the world's attention as a serious public health problem with a direct impact on the safety of healthcare and is one of the greatest challenges to providing good quality healthcare[10].

Concerned with this situation, several international organizations have focused efforts on developing standards, guidelines, and preventative measures based on evidence to improve patient safety, particularly in relation to HAIs. Notable examples include the Centers for Disease Control and Prevention[6], the European Centre for Disease Control[11], and the Joint Commission on Accreditation of Healthcare Organizations[12], among others.

Along these lines, it is recommended that strategies be implemented for constant monitoring of healthcare practices, concentrating on costs and quality for improvement of patient safety[13]. As part of these efforts, scales can have a major influence on decisions about care, treatment and/or interventions, and formulation of healthcare programs and institutional policies[8].

It is clear that use of scales is integral to the process of scientific development in healthcare and they

are pervasive from training, through research, to practical application of the knowledge acquired and both the process of construction of scales and their utilization are important, complementing each other and leading to benefits through systematic patient assessment[14].

For nurses, in general, it is very important to have access to scales of high psychometric quality that can measure the complex and important constructs involved in guiding nursing care[15], since nurses' involvement in assessments underpins integrated and individualized care for patients and their families[16]. However, before a scale can be administered and considered trustworthy, it must undergo a process of instrument validation consisting of analysis of its psychometric qualities, designed to improve its application and make it more objective[17].

One of the steps in validation of scales is face validation, the purpose of which is to establish the scale's acceptability in the setting in which it will be employed, which is part of establishing that the scale measures what it appears to measure[18], based on experts' subjective, but criteria-based, judgments[15]. In turn, content validity is considered an essential step because it represents the first of the mechanisms for associating abstract concepts with observable and measurable indicators[19,20].

Both face and content validity can be verified using a committee of experts, which is a process that makes it possible to obtain a collective opinion on a given phenomenon, such as best clinical practice[21] and is a widely-used technique and one that has a considerable influence on refining items with more potential for the scale[19].

Working from these reflections, and bearing in mind that the many stages of constructing a scale include a variety of types of validation, the objective of this study is to validate the face and content of a new scale for measurement of HAIs risk in hospitalized adults, by consensus between experts.

MATERIALS AND METHODS

Study design

This is a methodological study to evaluate the face and content validation of the RAC (Rodríguez-Almeida-Cañon) Adult Infection Risk Scale, which adopted psychometric procedures recommended in the literature[22,23]. The research project began with construction of a scale based on a systematic review with meta-analysis[24]. The first version of the scale was established from that review.

Description of the scale

A literature search followed by analysis of 65 studies[24] identified 15 risk factors for HAIs in hospitalized adults, which were transformed into the precursor items for the first version of the scale. It was found that these items fitted a two-dimensional model consisting of intrinsic factors and extrinsic factors, with 8 items in the first dimension and 7 items in the second dimension.

Within this conceptualization, the intrinsic factors are physiological characteristics or conditions of the patient at the time of admission and the extrinsic factors are those that involve the treatment provided[25]. Additionally, operational

definitions for each risk factor were formulated, to aid in comprehension of the concept at the time of assessment by the professional, and reduce confounding bias introduced by the probability of misinterpretation.

The scale response options comprise categorical scales, varying by risk factor, for example: nutritional status: normal, underweight, or overweight, etc. Likert scales from 0 to 3 points were then adopted to measure the responses according to the questionnaire items.

The healthcare professional who will eventually apply the scale should choose a single option per question. The total score is then calculated by summing the scores for each response, with total a score that can vary from 4 to 35 and is then categorized as low risk: 4-11, intermediate risk: 12-21, or high risk: ≥22, so that hospitalized adults with higher scores are at higher risk of developing a nosocomial infection. These values and scores were obtained according to the reported prevalence of risk factors independently associated with HAIs, previously identified in a systematic review[24].

Procedures

Data collection was conducted from June to December in 2016. The number of experts was chosen using a validated model[26], employing statistical tests. There is no consensus in the literature on the definition of experts, but the authors identified clinical experience and theoretical knowledge as important.

The sample size was set according the following parameters of interest: 95% confidence level (the Z -value associated with 95% is = 1.96); sampling error of 10% and expected proportion of experts of 95%. Therefore, the calculation was as follows: $n = 1.96^2*0.95* (1-0.95)/0.10^2 = 18$ experts, and to account for possible losses from the sample, a further 20% was added, estimating losses due to non-return of material or due to incomplete material in the absence of repeat contact with the person in question, resulting in a total of 23 experts from different states in Brazil.

In addition to being health professionals with a Master or Ph.D degree, inclusion criteria defined for the experts were a minimum of two of the following criteria: minimum 2 years' experience in adult inpatient wards; minimum of 1 year's experience on a Nosocomial Infection Control Commission, and experience with research related to HAIs and/or publications about HAIs.

Experts were recruited using a snowball-effect sampling strategy, relying on nomination of some researchers, selected participants, via the *Lattes* platform (a standardized virtual system that combines databases of curricula vitae, research teams, and institutions, in a single information system covering Science and Technology in Brazil), which is administered by the *Conselho Nacional de Desenvolvimento Científico* (CNPq – National Council for Scientific and Technological Development).

Potential participants were identified by searching for the keywords: construction/validation of scales or instruments and/or infection prevention and control. This type of sample strategy is one option for exchanging knowledge within the scientific community, attempting to capture the most up-to-date knowledge from different settings

and experiences, in order to acquire significant results from the many different contexts.

After identification of potential expert participants, an invitation letter was sent by e-mail containing all of the relevant information and indications related to the study. A time limit of 1 month was set for recipients to return this material, and experts were also excluded if they returned incomplete forms and failed to correct omissions even after the material had been returned to them and they had been contacted by the researcher.

The first version of the scale was evaluated in its entirety to determine whether its scope was comprehensive and its items were assessed individually for clarity and relevance. Clarity assessment focused on the wording of items, i.e. on whether the concept was understandable and whether it was evidently congruent with what it was intended to measure. In the relevance assessment, the experts indicated whether the items truly reflect the concepts involved and whether these are relevant and achieve the objectives[27].

The validity of content of the scale was tested using the Content Validity Index (CVI). The CVI measures the proportion of experts in agreement on features of the questionnaire and its items, initially each item is analyzed individually and then the instrument is assessed as a whole. The method employs a Likert scale with four levels, as follows: 1-not relevant; 2-somewhat relevant; 3-quite relevant; 4-highly relevant. There is no midpoint to neutral score to avoid ambivalence when interpreting the analyses.

According to experts recommendations[19] about development of health measurement scales, items scored as "2" or "3" were revised and items scored as "1" were eliminated, in accordance with the clarity and relevance of each item, in addition to work in the literature doing likewise[20,22,23].

Statistical analysis

The CVI for each item (I-CVIs) was calculated using the following formula: CVI= (number of responses scoring 3 or 4) / (total number of responses)[20]. The entire set of items on the scale was evaluated using the mean of the I-CVIs calculated separately and dividing by the number of items considered in the assessment. The criterion for acceptance between the experts for assessments of the items individually was set at a level of agreement exceeding 0.80, as recommended in the literature[22,28].

The CVI for the whole scale was calculated by summing the CVIs calculated separately and dividing by the number of items considered in the assessment, with a cutoff of 0.80 recommended for new instruments[8,28], which was adopted for this study.

The data collected were organized using an electronic spreadsheet in Excel and exported to Stata 11.1® for statistical analyses.

Ethical considerations

This study was approved by the Ethics Committee under protocol number 160231 and all experts who were invited to participate accepted signed a free and informed consent form electronically.

RESULTS

Description of the experts

A total of 23 health professionals accepted and completed the data collection questionnaires. Table 1 shows a summary of the profile of these professionals. These results show that there was a predominance of females among the study participants. The majority of young adults is likely to be linked with working age, and the majority of the sample work in the Southeast region, the region with the largest population in Brazil.

Table 1. Demographic characteristics of expert practitioners. Porto Alegre, RS, Brazil, 2017

Variable	n=23
Gender, Female†	22 (95.7)
Age/years*	43.4 ± 10.7
Region of origin†	
Southeast†	10 (43.5)
South†	6 (26.1)
Centro-West†	3 (13.0)
Northeast†	2 (8.7)
North†	2 (8.7)
Graduate qualifications	
Postdoctoral research†	1 (4.3)
Postdoctoral research (in progress)†	1 (4.3)
PhD†	11 (47.8)
PhD ((in progress)†	5 (21.7)
Masters†	15 (65.2)
Postgraduate certificate†	14 (60.9)
Postgraduate certificate (in progress)†	1 (4.3)
Residency†	4 (17.4)
Nursing experience*	18.9 ± 11.4
Current nursing role	
Health service†	4 (17.4)
Teaching†	4 (17.4)
Health service, Teaching and Research†	17 (73.9)

*Mean ± standard deviation; † n (%).

With relation to academic qualifications, a large proportion of the professionals recruited reported several postgraduate courses, such as: postgraduate certificates, Masters and Ph.D degrees, some completed and others in progress, as shown in Table 1.

Length of experience teaching, in practice, and in research ranged from 3 to 36 years, with a mean of 18.9 years. With regard to job roles, the great majority of the experts worked in several settings, ranging from health services to teaching and research.

Face and content validation

Consensus was achieved with a single round, with analyses for validation of face, which deals with the clarity of each risk factor and their respective operational definitions, and those for response categories and score gradations achieving a mean level of agreement of 0.88. The experts agreed with the dimensions, but recommended small modifications to some items, and those suggestions with support in the literature were accepted and acted on.

Only six experts considered that it was necessary to make some changes in the items, and the item gender remained unchanged because there were no suggestions for modification. Table 2 shows a summary of the experts' opinions. The dimension of intrinsic factors, which comprises items one to eight (Table 2), had good indices of acceptance by the experts, but certain suggestions were made with relation to some of the questions in order to improve understanding of the content expressed by the scale. Items 3, 6, 7 and 8 were all reformulated to improve understanding, and additional stratification of response categories was performed for items 2, 3, 4, 6 and 8, while the operational definitions for items 4 and 7 were refined to make their concepts clearer. The scores for these items ranged from 0.83 to 1.0, supporting the content validity of the items in the scale.

The dimension of extrinsic factors comprises items nine to fifteen (Table 2) and no changes were suggested to the items themselves, but it was necessary to make some alterations, increasing the number of response categories for items 10, 12, 13, 14 and 15 and refining the operational definitions for items 9, 11, 13, 14 and 15, as suggested by the experts, although the set of items in this dimension nevertheless had agreement scores ranging from 0.83 to 1.0.

Table 2. Experts' assessments, by Adult Inpatients Infection Risk Assessment scale components. Porto Alegre, RS, Brazil, 2017

Dimensions	Item numbers	Item	Experts' assessments								Suggestions	n (%)	
			Risk factor		Response categories		Score gradations		Operational definition				
			NR	R	NR	R	NR	R	NR	R		NR	R
Intrinsic factors	1	Gender	x		x		x		x		• No suggestions	23 (100)	0 (0.0)
	2	Age	x			x	x			x	• Stratify the number of response categories to include other age groups. • Refine operational definition.	18 (78.3)	5 (21.7)
	3	Smoking		x		x		x	x		• Reformulate item to be more comprehensive. • Stratify number of response categories to include passive smokers.	17 (74.0)	6 (26.0)
	4	Alcohol consumption	x			x	x			x	• Stratify the number of response categories to include social drinkers. • Refine operational definition.	18 (78.3)	5 (21.7)
	5	Nutritional factor	x		x		x			x	• Include formula to calculate body mass in the operational definition.	22 (95.7)	1 (4.3)
	6	Comorbidities		x		x	x		x		• Reformulate item using more everyday language. • Stratify the number of response categories to include immunodeficiency diseases.	19 (82.6)	4 (17.4)
	7	Non - surgical injury		x	x		x			x	• Reformulate item using more up -to- date language.	19 (82.6)	4 (17.4)
	8	Physical mobility		x		x	x		x		• Stratify the number of response categories to include patients who can move themselves with or without aid.	21 (91.3)	2 (8.7)

Extrinsic factors	9	**Previous admission**	x	x	x	x	• Include duration of prior admission in operational definition.	20 (87.0)	3 (13.0)
	10	**Transfer**	x	x	x	x	• Stratify the number of response categories to include other units and departments of patient origin.	17 (74.0)	6 (26.0)
	11	**Admission unit**	x	x	x	x	• Make it clear in operational definition that admission unit refers to the hospital department at the time of assessment.	22 (95.7)	1 (4.3)
	12	**Length of hospital stay**	x	x	x	x	• Stratify the number of response categories, because occurrence of infection is related to increasing numbers of days in hospital.	19 (82.6)	2 (8.7)
	13	**Surgery during current admission or previous 12 months**	x	x	x	x	• Stratify more response categories according to classification of infection potential. • Define time since surgery to be considered in assessment in the operational definition.	17 (74.0)	6 (26.0)
	14	**Invasive procedure(s)**	x	x	x	x	• Stratify more response categories according to the level of complexity of each procedure. • Define time since procedure to be considered in assessment in the operational definition.	19 (82.6)	4 (17.4)
	15	**Prior pharmacological and/or non - pharmacological treatment**	x	x	x	x	• Stratify more response categories according to adverse effects of medications. • Include administration route and time of ingestion of medications in the operational definition.	17 (74.0)	6 (26.0)

NR: No recommendations; R: Recommendations.

Regarding to the relevance of the items, the experts considered that all of them were congruent with the scale construct, with a mean agreement of 0.92. The judges agreed that the items are relevant and applicable to clinical practice (Table 3).

Table 3. Analysis of agreement of the Adult Inpatients Infection Risk Assessment scale. Porto Alegre, RS, Brazil, 2017

Dimension	Item numbers	Item	Clarity		Relevance		S-CVI
			Number in agreement	Item CVI	Number in agreement	Item CVI	
Intrinsic factors	1	Gender	23	1.00	23	1.00	
	2	Age	23	0.87	23	0.91	
	3	Smoking	23	0.91	23	0.87	
	4	Alcohol consumption	23	0.83	22	0.96	
	5	Nutritional factor	23	0.96	23	1.00	
	6	Comorbidities	23	0.83	23	0.91	
	7	Non-surgical injury	23	0.83	23	0.91	
	8	Physical mobility	23	0.87	23	0.96	
Extrinsic factors	9	Previous admission	23	0.83	23	0.87	**0.9**
	10	Transfer	22	0.83	22	0.83	
	11	Admission unit	23	0.96	23	0.96	
	12	Length of hospital stay	23	0.87	23	0.91	
	13	Surgery during current admission or previous 12 months	23	0.83	23	0.96	
	14	Invasive procedure(s)	23	0.83	23	0.87	
	15	Prior pharmacological and/or non-pharmacological treatment	23	0.91	23	0.83	
		Proportion of experts/Items-Total Content Validity Index	-	0.88	-	0.92	-

CVI: Content Validity Index; S-CVI: Scale-Content Validity Index.

The result of the calculation for the global CVI of this version of the scale was 0.90, indicating that it is representative of the content to be studied for measurement of infection risk in adults, as shown in Table 3.

DISCUSSION

This study developed and evaluated the validity of face and content of the RAC (Rodríguez-Almeida-Cañon) Adult Infection Risk Scale, a new instrument for measuring HAIs risk in hospitalized adults.

No scales were found in the literature that assess the risk factors for occurrence of HAIs in adults and so the findings of this study cannot be correlated with those for other similar scales, since this is an unprecedented study that seeks solutions for problems that involve the profession

and human health, filling a gap that exists both in the field of professional practice and in teaching and research and contributing to draw training and professional practice closer together.

According to the World Health Organization, the risk factors for HAIs vary according to the type of healthcare center and the service through which the patient is admitted and are partially different in developing countries. Further research is very much needed to identify models that can be used to make estimates that are more predictive of HAIs[1].

The healthcare team, and especially the nursing staff, have moments of essential contact with the patients that enable them to monitor a range of changes. The scale developed in this study can be used as part of screening for risk factors and, consequently of infections.

The results of this study are a supplement to the stages of scale validation, describing tests applied to the scale to test its face and content validity, since analysis by a panel of experts on a given area of knowledge contributes to improving and legitimizing a new instrument under development[29].

Therefore, these types of validations are an important step in the effort to provide professionals in clinical practice with a tool that aids in consolidation of a culture of safety and which can have results in safer and higher quality nursing care.

The findings indicate a scale for measurement of infection risk in hospitalized adults comprising two dimensions: intrinsic factors and extrinsic factors. These dimensions are made up of eight and seven items, respectively, with satisfactory face validity indices, as shown by the mean CVI of 0.90, a value recognized as adequate in the literature[8].

The overall CVI score was similar for the group of items in each dimension, which occurred because the expert judges awarded agreement values of 3 (agree partially) and 4 (totally agree) to different items that were in the same dimension. It is worth noting that both dimensions have a similar number of items and that the final result showed that they were congruent with each other.

It should be pointed out that the category of extrinsic factors included an infrastructure factor, which refers to the collection of resources that are available to the health professional, including number of staff, equipment, and physical area[30]. It was decided not to include this item because it was not covered in the literature reviewed and also because the indicators that it contains, such as contaminated air conditioning, contaminated water system, physical design of the department, and others, are central concerns of the managers of healthcare organizations and are not the direct or sole responsibility of the health professionals.

There is no doubt of the importance of this subject, bearing in mind the range of possible complications, but it cannot be concluded that the dimensions and factors identified in this study encompass all that is known on the subject, although they are the elements mentioned with greatest frequency in the literature.

One limitation of this study is that since it was conducted exclusively in Brazil it may not have covered different knowledge about and experience of the subject that exists in other popula-

tions. It is suggested that future confirmatory studies should be undertaken in other places in order that cultural differences with relation to the scale's dimensions and items can be discussed.

Another limitation is related to the fact that the sample was entirely made up of nurses, even though other professionals from the multidisciplinary team were invited to take part. It is therefore recommended that validation by consensus be conducted in other categories of the healthcare professions, since the care provided to people in hospital involves a multidisciplinary team.

CONCLUSIONS

The RAC Adult Infection Risk Scale was considered valid in terms of face and content, bearing in mind the careful and detailed process of assessment of the scale and the experts' suggestions for improvements to make it better suited to its target public, since this scale is designed to enable identification and measurement of infection risk in hospitalized adults, as an important measure for progress in actions to prevent HAIs. The RAC Adult Infection Risk Scale can be used as a technology of low cost for the measurement of the risk of infection in adult patients, which allows the planning of more accurate and organized interventions of the health team targeting at preventive and safe care during hospitalization. In addition, this tool may favor risk management, patient safety and hospital infection control to achieve best practices and, therefore, contribute to indicators of quality of care[31].

Another important step towards this instrument can be considered valid and reliable is to evaluate its reliability and construct validation, which the authors have already accepted as their next study. The intention is that the final result will be a scale that is a practical instrument of use to health professionals for identification of patients at increased risk, enabling them to plan and implement interventions to improve patient safety and reduce the risk of infection among hospitalized adults.

Conflict of interest: The authors declare no conflict of interest.

REFERENCES

1. **Allegranzi B, Bagheri-Nejad S, Combescure C, Graafmans W, Attar H, Donaldson L, et al.** Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. *Lancet*. 2011; 377 (9761): 228-41. http://dx.doi.org/10.1016/S0140-6736(10)61458-4
2. **Centers for Disease Control and Prevention.** National and State Healthcare-Associated Infections progress report. 2016. [online] available: http://www.cdc.gov/HAI/pdfs/progress-report/hai-progress-report.pdf
3. **Bammigatti C, Doradla S, Belgode HN, Kumar H, Swaminathan RP.** Healthcare Associated Infections in a Resource Limited Setting. *J. Clin Diagn Res*. 2017;11(1):OC01-OC04. https://doi.org/10.7860/JCDR/2017/23076.9150
4. **Pereira FG, Chagas AN, Freitas MM, Barros LM, Caetano JA.** Caracterização das infecções relacionadas à assistência à saúde em uma Unidade de Terapia Intensiva. *Vigil. sanit. debate*. 2016;4 (1): 70-7. http://dx.doi.org/10.3395/2317-269x.00614
5. **Mehta Y, Gupta A, Todi S, Myatra S, Samaddar DP, Patil V, et al.** Guidelines for prevention of hospital acquired infections. *Indian J Crit Care Med*. 2014;18 (3): 149-63. https://doi.org/10.4103/0972-5229.128705
6. **Centers for Disease Control and Prevention.** Guideline for isolation precautions: Preventing transmission of infectious agents in healthcare settings. 2014. [online] available: http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf

7. **Bergstrom N, Braden BJ, Laguzza A, Holman V.** The Braden scale for predicting pressure sore risk. *Nursing Research*. 1987;36(4):205-210. https://doi.org/10.1097/00006199-198707000-00002
8. **Coluci MZ, Alexandre NM, Milani D.** Construction of measurement instruments in the area of health. *Cien Saude Colet*. 2015;20(3):925-36. https://doi.org/10.1590/1413-81232015203.04332013
9. **Keszei A, Novak M, Streiner DL.** Introduction to health measurement scales. *J Psychosom Res*. 2010;68 (4):319-23. https://doi.org/10.1016/j.jpsychores.2010.01.006
10. **Junior CN, Padoveze MC, Lacerda RA.** Governmental surveillance system of healthcare-associated infection in Brazil. *Rev Esc Enferm USP*. 2014;48 (4):657-62. https://doi.org/10.1590/S0080-623420140000400012
11. **European Centre for Disease Prevention and Control.** Healthcare Associated Infection (HAI), 2017. [online] available: http://ecdc.europa.eu/en/healthtopics/Healthcare-associated_infections/Pages/index.aspx#sthash.bdrTWt7C.dpuf
12. **Joint Comission on Acreditation of Healthcare Organization.** List of Joint Commission approved subjects for screening indicators for hospital. 2006. [online] available: http://www.jointcomission.org
13. **Menegueti MG, Canini SR, Bellissimo-Rodrigues F, Laus AM.** Evaluation of Nosocomial Infection Control Programs in health services. *Rev Lat Am Enfermagem*. 2015;23 (1): 98-105. https://doi.org/10.1590/0104-1169.0113.2530
14. **Borghardt AT, Prado TN, Araújo TM, Rogenski NM, Bringuente ME.** Evaluation of the pressure ulcers risk scales with critically ill patients: a prospective cohort study. *Rev Lat Am Enfermagem*. 2015; 23 (1):28-35. https://doi.org/10.1590/0104-1169.0144.2521
15. **Díaz-Heredia LP, Muñoz-Sánchez AI, de Vargas D.** Reliability and validity of spirituality questionnaire by Parsian and Dunning in the Spanish version. *Rev Lat Am Enfermagem*. 2012;20(3):559-66. https://doi.org/10.1590/S0104-11692012000300018
16. **Fernandes MG, Costa KN, Santos SR, Pereira MA, Oliveira DS, Brito SS.** Risco para úlcera por pressão em idosos hospitalizados: aplicação da Escala de Waterlow. *Rev Enferm UERJ*. 2012;20 (1):56-60.
17. **Almeida CM, Rodrigues VM, Escola JJ.** The representations of human vulnerability held by health workers – development and validation of a scale. *Rev Lat Am Enfermagem*. 2013; 21 (Spec):29-37. https://doi.org/10.1590/S0104-11692013000700005
18. **Pasquali L.** Psychometrics. *Rev. esc. enferm. USP*. 2009;43 (spe): 992-9. https://doi.org/10.1590/S0080-62342009000500002
19. **Streiner DL, Norman GR.** Health measurement scales. A practical guide to their development and use. 4th ed. Oxford University Press, New York, 2008.
20. **Wynd CA, Schmidt B, Schaefer MA.** Two quantitative approaches for estimating content validity. *West J Nurs Res*. 2003;25(5):508-18. https://doi.org/10.1177/0193945903252998
21. **Lunne M, McGuire M, Endozo N, McIntosh-Waddy D.** Consensus-validation study identifies relevant nursing diagnoses, nursing interventions, and health outcomes for people with traumatic brain injuries. *Rehabil Nurs*. 2010;35 (4):161-66. https://doi.org/10.1002/j.2048-7940.2010.tb00042.x
22. **Lynn MR.** Determination and quantification of content validity. *Nurs Res*. 1986;35 (6): 382-6. https://doi.org/10.1097/00006199-198611000-00017
23. **Polit DF, Beck CT.** The content validity index: are you sure you know what's being reported? Critique and recommendations. *Res Nurs Health*. 2006;29 (5): 489-97. https://doi.org/10.1002/nur.20147
24. **Rodríguez-Acelas AL, Almeida MDA, Engelman B, Cañon-Montañez W.** Risk factors for healthcare-associated infection in hospitalized adults: Systematic review and meta-analysis. *Am J Infect Control*. 2017;45(12):e149-e156. https://doi.org/10.1016/j.ajic.2017.08.016
25. **Guzmán-Herrador B, Molina CD, Allam MF, Navajas RF.** Independent risk factors associated with hospital-acquired pneumonia in an adult ICU: 4-year prospective cohort study in a university reference hospital. *J Public Health (Oxf)*. 2016;38 (2):378-83. https://doi.org/10.1093/pubmed/fdv042
26. **Lopes MV, Silva VM, Araujo TL.** Métodos de pesquisa para validação clínica de conceitos diagnósticos Inc: Herdman TH; Carvalho, EC (org) PRONANDA: Programa de Atualização em Diagnósticos de Enfermagem: conceitos básicos. *Artmed/Panamericana*. Porto Alegre, 2013. https://doi.org/10.1590/S0034-71672013000500002
27. **Grant JS, Davis LL.** Selection and use of content experts for instrument development. *Rev Nurs Health*. 1997;20 (3):269-74. https://doi.org/10.1002/(SICI)1098-240X(199706)20:3<269::AID-NUR9>3.0.CO;2-G
28. **Polit DF, Beck C, Owen S.** Is the CVI an acceptable indicator of content validity: appraisal and recommendations. *Res Nurs Health*. 2007;30 (4): 459-67. https://doi.org/10.1002/nur.20199
29. **Amendola F, Alvarenga MR, Gaspar JC, Yamashita CH, Oliveira MA.** Validade aparente de um índice de vulnerabilidade das famílias e incapacidade e dependência. *Rev Esc Enferm USP*. 2011; 45 (spe2):1736-42. https://doi.org/10.1590/S0080-62342011000800017
30. **Couto RC, Pedrosa TM, Cunha AF, Amaral DB.** Infecção hospitalar e outras complicações: Epidemiologia, controle e tratamento. 4th ed. *Guanabara*, São Paulo, 2009.
31. **Rodríguez-Acelas AL, Cañon-Montañez W.** Contribuciones de las escalas en salud como herramientas que influencian decisiones en el cuidado de los pacientes. *Rev Cuid*. 2018; 9(1): 1949-60. https://doi.org/10.15649/cuidarte.v9i1.498